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WECHES EOCENE OSTRACODA FROM SMITHVILLE, TEXAS[1]

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ABSTRACT—Sixty-four species of Ostracoda, representing twenty-three genera and four families, are figured and discussed. Twenty-seven of the species and one name are new. The fauna was collected from the Weches formation, Claiborne Eocene, at exposures on Colorado River at Smithville, Bastrop County, Texas. Some ontogenetic relationships are indicated, and a discussion of some of the genera allied to *Cythereis* is included.

INTRODUCTION

PERHAPS the best known locality in the Eocene of Texas is the outcrop of the Weches formation on Colorado River near Smithville in Bastrop County. Most paleontologists of the Gulf Coast have examined material from this exposure, and yet oddly enough the literature contains neither check lists nor detailed descriptions of the entire faunas of Ostracoda and Foraminifera present. Several fairly lengthy reports on the Ostracoda of Claiborne Eocene sediments have been published, together with a number of short papers on the occurrence of one or more genera. Hence in its initial stages, it appeared that the present study of the Weches Ostracoda from Smithville might be presented in the form of a check list. It soon became evident, however, that necessary generic changes and erroneous identification of species were too numerous to be abbreviated into check list form. In addition to this a large quantity of material was examined as the work progressed, and a number of hitherto undescribed species were encountered. It therefore seemed advisable to figure all species identified, and to include synonomies and comments on that portion of the fauna previously reported.

A condensed summary of the stratigraphy of the Claiborne of Texas, as used in this report, and its position in the Eocene may prove helpful.

- Jackson group
- Claiborne group
  - Yegua formation
  - Cook Mountain (Crockett) formation
  - Sparta sand
  - Veches formation
  - Queen City sand
  - Reklaw formation
  - Carrizo sand
- Wilcox group
- Midway group

The writer wishes to express his gratitude to H. B. Stenzel of Austin, Texas, for his helpful suggestions on the correlation and collecting of material upon which this report

[1] Published with the permission of the Stanolind Oil and Gas Company.

is based. Henry V. Howe, of Baton Rouge, Louisiana, very kindly checked terminology of specific names in his file on Ostracoda. Charles W. Stuckey, Jr., of Houston, Texas, was of great assistance in the field and offered helpful suggestions while the work was in progress. A number of publications were made available to the author through the kindness of M. C. Israelsky. Thanks are likewise due J. B. Garrett and A. D. Ellis, Jr., paleontologists of Houston, Texas, and W. A. Nowotny and C. F. Washburn, geologists of San Antonio, Texas, all on the staff of Stanolind Oil and Gas Company, who participated in the collection of the several groups of samples used in this study.

The type specimens upon which this report is based will be deposited in the Louisiana State University Museum, Baton Rouge, Louisiana. All illustrations were drawn by the author.

THE WECHES FORMATION

The name Weches was proposed by Wendlandt and Knebel (1929, p. 1356) for strata between the Queen City and Sparta formations exposed in East Texas. No type section of the formation was indicated by these authors. The term was likewise used by Ellisor (1929) for these beds in her correlation of the Claiborne of East Texas and Louisiana. The extension of the Cane River formation of Louisiana into Texas stratigraphically below the Reklaw, as was indicated in this paper, has not been substantiated by subsequent work. H. B. Stenzel, foremost authority on the Claiborne section, has recently been engaged in an exhaustive stratigraphic study of the Weches formation along most of its outcrop in central Texas. The publication of this work should do much to clarify our views concerning these strata. The exposures at Smithville in Bastrop County on which the present report is based were described in detail by Stenzel (1940a). Four sections along Colorado River were figured and their correlation indicated. In these sections, the Weches was divided into the Tyus (at the base), Viesca, and Zilpha members. In his unpublished report, Stenzel[2] advised that the term Therrill is being used as the name properly applied to the uppermost member, a term which he had used in connection with this unit in his work on the geology of Leon County (see Stenzel, 1938, p. 97).

[2] Personal communication, under date of October 2, 1944.

DESCRIPTION OF SAMPLES

Exposures of the Weches formation on Colorado River in the vicinity of Smithville were studied and systematically sampled at short intervals up the bluff. Some samples are sparsely fossiliferous or entirely barren. These sections, collected by the author and party, were supplemented by two other collections from the vicinity, one of which contained additional samples from the main exposure. The distance of each section from the bridge over Colorado River at Smithville was obtained by pacing, and the footage between samples was estimated by eye in the field. Samples are numbered consecutively beginning with the lowest, to facilitate checklisting. Wherever possible, the relationship of samples to key beds established by Stenzel (1940a) is given. No attempt has been made to correlate samples with the section measured by Deussen (1924, p. 70), as Stenzel's recent work supersedes it. Deussen's section, attributed to E. H. Sellards, may be referred to in this JOURNAL (see Sutton and Williams, 1939, p. 561). It was likewise given by Plummer (1932, p. 640).

Locality 1.—Deep gulley into Colorado River, 15 yards east (downstream) of bridge at Smithville, Texas. This section, in the upper part of the Therrill member, is unfossiliferous. Collected by M. B. Stephenson, C. W. Stuckey, Jr., and W. A. Nowotny (loc. 38), September 17, 1944.

Sample 40.—Gray clay, near head of gulley.

Sample 39.—Gray clay, 2 feet below sample 40.

Sample 38.—Gray clay with interbedded micaceous fine sand, about 10 feet lower than sample 39, and 70 feet down gulley.

Sample 37.—Brownish gray clay, carrying some carbonaceous matter and clusters of gypsum crystals, 20 feet down gulley from sample 38, but appearing to overlie it. This sample is at mouth of gulley.

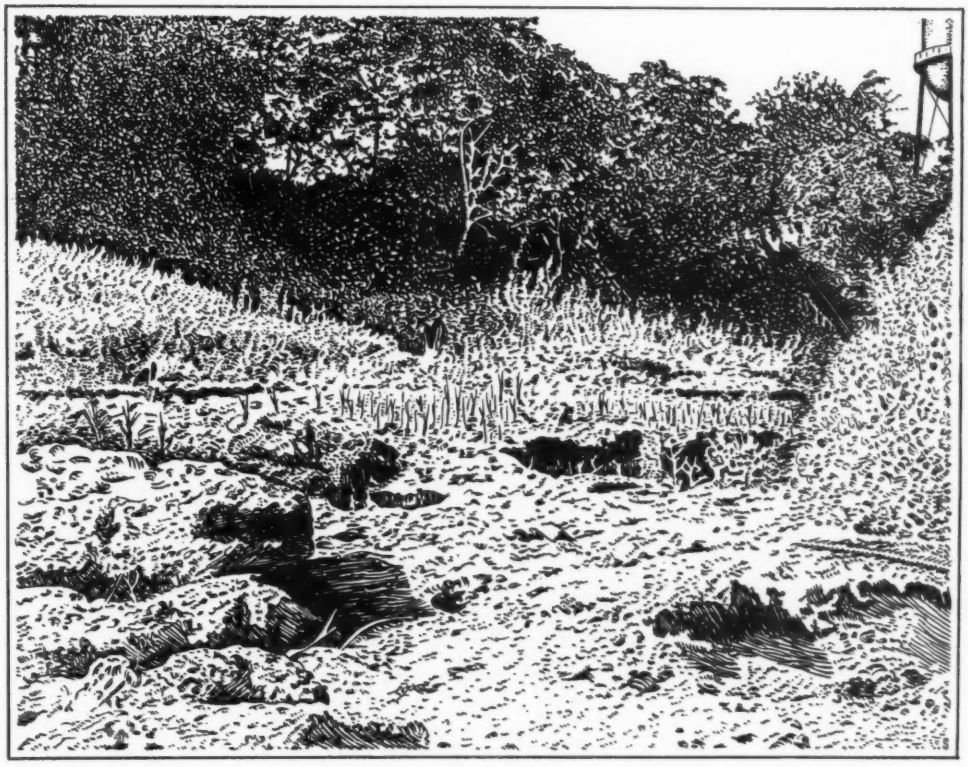


FIG. *1*—Main exposure of the Weches formation on Colorado River at Smithville, Texas. (Sketched by the author from a photograph taken from near water's edge, September 17, 1944.)

Locality 2.—Directly under highway bridge over Colorado River at Smithville, Texas. This section, like the one above, represents the upper Therrill. No microfossils were encountered. Collected by J. B. Garrett and C. F. Washburn (loc. 180), October, 1940.

Sample 36.—Brown clay, 2 feet below top of exposure.

Sample 35.—Dark gray clay, 4 feet below sample 36, and 3 feet below one-foot sand bed.

Sample 34.—Iron-stained gray sand, 4 feet below sample 35, and one foot above water level of Colorado River. Top of sand section extends 2 feet higher.

Locality 3.—Section 100 yards west (upstream) of bridge over Colorado River at Smithville, Texas, on right bank of river. This section is somewhat below the middle of the Therrill (Zilpha) member, according to the 1940 Guidebook of the South Texas Geological Society. Collected by M. B. Stephenson, C. W. Stuckey, Jr., and W. A. Nowotny (loc. 39), September 17, 1944.

Sample 33.—Brown thinly laminated sandy clay with limonite streaks, at top of exposure and about 25 feet below level of flood plain.

Sample 32.—Same lithology, 2 feet below sample 33, and 6 feet above sandstone ledge.

Sample 31.—Gray fine-grained quartz sand, 4 feet above hard sandstone.

Sample 30.—Thinly laminated ferruginous fine sandstone and brown clay, 1½ feet above sandstone ledge. Unfossiliferous.

Sample 29.—Light-gray iron-stained mas-

sive fine sand, cracked and filled with limonite streaks, 6 inches above sandstone. Unfossiliferous.

Sample 28.—Dark brownish-gray clay carrying scattered fine lignite flakes, with thin laminae of limonite-stained fine-grained sandstone covered with selenite crystals, immediately overlying hard sandstone. Sample carries a sparse fauna of arenaceous Foraminifera.

Sample 27.—Sandstone ledge, consisting of brownish gray firm, fine-grained sandstone (Bed IIIm of Guidebook). Unfossiliferous.

Sample 26.—Argillaceous, ferruginous fine sand with some interbedded gray clay carrying lignite, 1 foot below sandstone. Unfossiliferous.

Sample 25.—Dark-gray clay with limonite stains, containing some glauconite, carrying gastropods and pelecypods, 2 feet below hard sandstone ledge. Some calcareous Foraminifera are present in addition to arenaceous forms noted in sample 28. Ostracoda in this bed include *Haplocytheridea wallacei* and *Pyricythereis alabamensis*.

Locality 4.—Right bank of Colorado River, 150 yards west (upsteam) of highway bridge at Smithville, Texas. See Section III of Guidebook of South Texas Geological Society (1940) for this locality. Ironstone concretions and Bentonite Bed of Guidebook are exposed a little downstream from locality. Collected by M. B. Stephenson, C. W. Stuckey, Jr., and W. A. Nowotny (loc. 40), September 17, 1944.

Sample 24.—Dark-gray highly ironstained clay with thin limonite laminae carrying selenite. This sample is 8 feet above "brown sand." (Brown sand is Bed IIIb of Guidebook.) Unfossiliferous.

Sample 23.—Coral bed, carrying abundant pelecypod fragments, 3 feet above "brown sand." Microfauna is similar to that in sample 25.

Sample 22.—Black highly carbonaceous clay with limonite streaks carrying selenite, just above "brown sand." This sample carries very rare Foraminifera and Ostracoda.

Sample 21.—Black firm glauconitic clay, highly fossiliferous, carrying gastropods and pelecypods, immediately below "brown sand." This sample contains a good fauna of Foraminifera and Ostracoda, all of which range upward into the overlying Cook Mountain formation with the possible exception of *Cythereis viescana*. This sample is lowermost Therrill ("Zilpha," Bed IIIa of Guidebook). Two feet only of this bed are exposed, remaining portion covered by alluvium.

Locality 5.—Main exposure of Weches formation, about 1000 feet west (upstream) of highway bridge over Colorado River at Smithville, Texas. This exposure is just above the riffles and below the water gauge. See Section II of Guidebook of South Texas Geological Society (1940) for this locality. Collected by M. B. Stephenson, C. W. Stuckey, Jr., and W. A. Nowotny (loc. 41), September 17, 1944.

Sample 20.—Brown, hard, ferruginous, glauconitic fossiliferous very fine-grained sandstone ledge at top of exposure, carrying small pelecypods and gastropods. A rather sparse fauna of ironstained Foraminifera includes *Textularia smithvillensis* and *Lamarckina claibornensis*. This is the highest sample from which a typical Weches assemblage of Foraminifera was obtained. Ostracodes are rare.

Sample 19.—Gray highly glauconitic fossiliferous clay between two ironstone ledges, 3 feet above oyster bed (Bed IId of Guidebook). This sample is immediately below sample 20, and carries a better preserved and more diversified Weches fauna of Ostracoda and Foraminifera.

Sample 18.—Brown, hard, ferruginous, glauconitic fossiliferous very fine-grained sandstone ledge, 2½ feet above oyster bed and 6 inches below sample 19. This sample carries pelecypods, gastropods, scaphopods, and a moderately good microfauna.

Sample 17.—Dark-gray glauconitic fossiliferous clay, 2 feet above oyster bed and 6 inches below sample 18. This bed contains common Mollusca, occasional Bryozoa, and numerous Foraminifera and Ostracoda.

Sample 16.—Coquina, 2 feet above oyster

bed and just below sample 17, carrying glauconite, very abundant Mollusca, and a good microfauna.

Sample 15.—Black highly glauconitic fossiliferous clay, immediately above oyster bed, containing Mollusca and a good microfauna.

Sample 14.—Oyster bed (Bed IId of Guidebook). Brown hard ferruginous glauconitic fossiliferous fine-grained sandstone with irregular lenses of clay. This resistant 2-foot bed forms the broad ledge which dips toward the river at this point. It contains numerous imbedded specimens of *Ostrea sellaeformis smithvillensis* Harris (1919, p. 11) (identification confirmed by H. B. Stenzel). A good microfauna was taken from softer portions of the ledge.

Sample 13.—Black highly glauconitic clay with numerous small pebbles, immediately underlying sample 14, carries a good microfauna.

Sample 12.—Black highly glauconitic clay, in part limonitic and tending to form a ledge, immediately under sample 13. Microfossils are iron-stained, and moderately diversified.

Sample 11.—Black highly glauconitic highly fossiliferous clay with limonite streaks, one foot below sample 12. An abundant and well preserved fauna of Ostracoda and Foraminifera is contained in this material.

Sample 10.—Dark-gray in part limonite-stained somewhat glauconitic clay, carrying occasional *Ostrea* and pelecypod shells and a well developed microfauna, one foot below sample 11.

Sample 9.—Same lithology, just above "lime bed" (Bed Ih of Guidebook). This is lowermost Viesca.

Sample 8.—Immediately below hard one-foot limestone ledge and 10 feet from water's edge, appears to be basal part of section, and represents top of Tyus member. A moderately developed microfauna is present.

Locality 6.—An additional collection of samples from the main exposure at Smithville, Texas, described as locality 5. Descriptions of samples are from field notes of the collectors, J. B. Garrett and A. D. Ellis, Jr. (loc. 63), August 15, 1937.

Sample 7.—Greensand marl just under first siderite ledge exposed, about halfway down bluff.

Sample 6.—Same lithology, just under second ledge, 3–4 feet below sample 7.

Sample 5.—Same lithology, just under third ledge, 2 feet below sample 6.

Sample 4.—Same lithology, 5 feet below sample 5, and just under fourth ledge, which is thick and very hard and forms the shoals.

Sample 3.—Same lithology, just under fifth ledge, 2 feet below sample 4.

Sample 2.—Glauconitic fossiliferous shale, just under sixth ledge, 2–3 feet below sample 3.

Locality 7.—Mouth of Gasley Creek, near Smithville, Texas. This creek discharges into Colorado River from the south, the distance from the bridge being given as 1600 feet by Plummer (1932, p. 640). Plummer indicated that some 20 feet of glauconitic marl, mostly unexposed, is present. The shell marl was below water level when visited by me in September, 1944. The present sample was collected by J. B. Garrett and A. D. Ellis, Jr. (loc. 64). August 15, 1937.

Sample 1.—Shell bed just under hard fossiliferous ledge near water level. Mollusca from this bed were described by Palmer (1928). No microfossils were found in this material from the Tyus member.

FORAMINIFERA

A number of Foraminifera from the Weches have been described in various papers dealing with the faunas of Claiborne sediments. A partial list, determined by Helen Jeanne Plummer, was published by F. B. Plummer (1932, p. 645). Cushman and Thomas (1929 and 1930) published on the faunas of the East Texas greensands; Weinzierl and Applin (1929) increased the number of known species; Hussey (1943) described species from the Cane River formation of Louisiana. Many of these Foraminifera are present in the Weches. In his zoning of the subsurface Claiborne sediments of Texas and Louisiana, Israelsky (1935, fig. 1) noted the occurrence of the useful guide foraminifers *Textularia smithvillensis* Cushman and Ellisor (1933), and somewhat below this species the appearance of *La-*

marckina claibornensis Cushman (1926). These species have been widely used as being indicative of the Weches, and their occurrence at Smithville is of interest, as is the range of the large undescribed species which will be referred to *Amphistegina* cf. *A. californica* Cushman and Hanna (1927, p. 56, pl. 6, figs. 3–5) for convenience. All three of these species make their appearance in sample 8, the lowermost ostracode-bearing material examined. *Amphistegina* cf. *A. californica* occurs fairly commonly as high as sample 13, it is rare in sample 14, and a single specimen in sample 15 places its uppermost occurrence immediately above the oyster ledge. *Lamarckina claibornensis* was found consistently up to and including sample 14 (the oyster ledge), from which point it was absent from the section until it reappeared in sample 19. Its upper range occurred in sample 20, the top of the main exposure, some four feet above the oyster ledge. This same material, sample 20, likewise carried the highest occurrence of *Textularia smithvillensis*.

The upper limit of the Weches strata at Smithville was placed at a regional disconformity by the careful field work of H. B. Stenzel. The economic geologist and micropaleontologist would almost surely differ in their correlation of these beds if they had been encountered as subsurface strata in drilling operations. The alternating fine sands and gray and brown clays above sample 28 carry no microfauna in material available to the author, and would very probably be included in the Sparta formation. Sample 28 carries a sparse fauna of arenaceous Foraminifera indicative of brackish-water environment. The beds become more marine downward from this point, with an increasing fauna of calcareous Foraminifera and some Ostracoda in clays interbedded with nonmarine strata. Foraminifera in these beds as low as sample 21 consist of species common to both Cook Mountain and Weches formations, and these beds could not be assigned an age older than Cook Mountain on the basis of micropaleontology. The top of the Weches would be placed at sample 20, uppermost occurrence of *Textularia smithvillensis*. It thus appears that subsurface correlations of the Weches probably place the top of the formation lower than its upper limit as observed in the field. Actual subsurface points on the top of the Weches, as expressed by the occurrence of the *Textularia*, are undoubtedly relatively higher in the Weches section than the range noted at the outcrop, due to a more optimum environment.

OSTRACODA

The Midway Ostracoda of Texas were described in this JOURNAL by Alexander (1934). Howe and Garrett (1934) reported on the Wilcox ("Sabine" of these authors) fauna of Louisiana. The Carrizo and Queen City formations are mostly unfossiliferous sands. A rather sparse ostracode fauna was described by the present author (Stephenson, 1944a) from the Reklaw formation. Sutton and Williams (1939) reported on a portion of the Weches Ostracoda at Smithville. The unfossiliferous Sparta sand lies below the Cook Mountain (Crockett), a formation carrying a good ostracode fauna in Louisiana, portions of which have been the subjects of short papers. The occurrences of species in the Cook Mountain of Texas recorded in this report were obtained from material collected by A. D. Ellis, Jr., at the Elm Creek localities in Lee County. These exposures were designated by Dumble (1918, pp. 102–106) as the type sections of his Yegua formation. Dumble included in his Yegua the marine strata overlying the Sparta sand. Stadnichenko (1927) described Foraminifera and Ostracoda from these outcrops, and the section was discussed by Gardner (1927). The Foraminifera were later presented as a "Yegua" fauna by Cushman and Applin (1943). This material contains the foraminifer *Ceratobulimina eximia* Rzehak, generally considered as a guide fossil of the Cook Mountain, and the faunas are definitely older than the *Eponides yeguaensis* zone of the subsurface Yegua. The Elm Creek localities are typical of beds now considered to be the Cook Mountain formation. Stenzel (1940) has aptly presented the complexities of the Yegua, and there have probably been more erroneous determinations of it than of any other formation of the surface Eocene section. It has been pointed out by Garrett (1936) that the foraminifer *Nonionella cockfieldensis*

Cushman and Ellisor actually occurs in the lowermost beds of the Jackson Eocene, rather than in the Claiborne. No surface fossiliferous marine Yegua material older than this basal Jackson and younger than Cook Mountain has come to the author's attention, although it is at times quite fossiliferous in the down-dip subsurface section. The Jackson Ostracoda have been reported from Louisiana in a bulletin by Howe and Chambers (1935).

Several aspects of the ostracode fauna at Smithville proved of interest. A large quantity of material has been examined, which revealed the presence of a number of species usually overlooked in a superficial study. Further, the necessity of systematically sampling an entire exposure has been demonstrated, as there is considerable variation in the faunal content as well as in the abundance of individual species in the various samples. Of particular interest is the very rare occurrence of a single finely pitted species of *Bairdia*, and the complete absence of the one or more smooth species of the genus which usually occur, often in considerable abundance, in most marine strata of the Gulf Coast Tertiary. Very rare specimens of *Cytheromorpha*, *Argilloecia*, and *Eucythere* were found in this material, while such genera as *Eocytheropteron* and *Krithe*, which might have been expected, were not. A rather good development of the genus *Monoceratina*, which includes five species, shows this to be a more abundant element of the assemblage than had been anticipated. The genus *Cytherura*, represented by four species, is very rare and restricted to oxidized samples. The genus *Orthonotacythere*, considered by Alexander (1933, p. 199) to have been derived from *Monoceratina*, was not found, leaving its upper known range to be Wilcox (see Howe and Garrett, 1934, p. 49). Several species previously believed confined to the Wilcox have been found in the Weches. A study of topotype material from localities of Stadnichenko (1927) has likewise led to identification of a number of Cook Mountain species hitherto unreported from the Weches.

Numerous valves representing molt stages of a number of Weches species have been identified and classed with the adult forms. The proper placement of such immature specimens was recognized as early as 1849 by Jones in his work on the Cretaceous of England. An example of this may be seen (Jones, 1849, p. 18, pls. 3, 4, figs. 10a–j) in his description and figures of *Cythereis quadrilatera* (Roemer). The characters of the young shell were noted, and dimensions and illustrations were given for young, immature, and adult specimens. Brady (1880) recognized as young forms a number of specimens from the *Challenger* dredgings, and classed them with the adults. His illustrations of *Cythere polytrema* (pl. 21, figs. 5a–h) include figures of three different molt stages. Regarding the various stages of growth shown by *Cythere dictyon*. Brady (p. 99, pl. 24, figs. 1a–y) stated in part:

> Many intermediate varieties might have been added to those given in the plate, but a careful examination of these figures will, I think, be sufficient to show pretty conclusively the unity of the series. The ventral ridge is conspicuous even in the very youngest shells (r–u), and in these the surface-ornament, though much more delicate than in the adult, is sufficiently obvious; this character becomes increasingly distinct with the age of the animal, until in what appear to be the very oldest examples (j, v) the reticulations have become very massive and rounded by constant depositions of calcareous substance, while the intervening fossae are proportionally deepened. It is not uncommon to find the sculptured ornament of Ostracoda filled up and partly obliterated in old age; possibly this might be the case in still older specimens of *Cythere dictyon* than those which have come under my observation, but at present I have seen no trace of the obliterating process in this species.

In his work on the Ostracoda of Bohemia, Vávra (1891, p. 25) noted nine successive stages of development, with the nauplii already encased in a bivalved carapace in the initial stage. Discussion is mainly concerned with soft parts of the body.

Müller (1894, pp. 173–188) presented a detailed discussion of ontogenetic relationships in his classic work on the fauna of the Gulf of Naples, noting that he had previously (1893, p. 355) reported the results of his investigation. The conclusions reached differed in some aspects from the earlier analysis made by Claus (1872, p. 151). The several developmental stages were isolated, and the shell characters and structure of soft body parts of each stage were discussed and figured for various families. As an example, all but the first of eight stages in

the development of *Macrocypris succinea* were distinguished (pp. 176–178), lengths of the series of carapaces were given, and peripheral contours indicated by outline drawings (pl. 33, figs. 1–7). A very brief discussion of the early stages of development was included by Müller (1912, p. 5) in his later compilation of Recent Ostracoda. Among the students of fresh-water ostracodes Fassbinder (1912, p. 12) recognized young stages of *Cypris pubera* in his careful study of marginal relationships of ostracode carapaces. Sharpe (1918) discussed the eggs and early stages of fresh-water forms, and noted (p. 798) that the animals molt many times before reaching maturity.

Several ontogenetic studies have more recently been published, notable among them being a detailed analysis of the immature stages of two species of *Cythereis* by Le Roy (1945), and a statistical and taxonomic treatment of the molt stages of the Pennsylvanian ostracode *Ectodemites plummeri* by Cooper (1945). The presence of molt valves of ostracodes in sediments carrying adult carapaces of the same species has been recognized by the writer for some time. The subgenus *Leptocytheridea*, proposed (Stephenson, 1937) under the genus *Cytheridea*, was later (Stephenson, 1941) demonstrated to consist of a group of young molts. *Haplocytheridea* and *Clithrocytheridea*, originally proposed as subgenera under *Cytheridea* (Stephenson, 1936), are now considered by the author to be distinct genera, and molts showing the shell characters described for *Leptocytheridea* are classed under the genera *Haplocytheridea* and *Clithrocytheridea*.

A number of molt valves of adult species of the genus *Cythereis* were encountered in the Weches. These specimens exhibit the characters of shell structure described by Howe (see Howe and Law, 1936, p. 57) for his genus *Archicythereis*, and Howe indicated that the forms included under the genus might be molts. Examples of such young molts of *Cythereis bursilloides* Stadnichenko (pl. 45, figs. 14–16) are included in this report. At my suggestion, LeRoy (1945, p. 82) recommended that the use of the genus *Archicythereis* be discontinued, and included previously described "species" showing the shell characters of *Archicythereis* in synonomy under adult species of *Cythereis*. Young molt stages of *Pyricythereis* such as those figured (pl. 42, figs. 22, 23) are not uncommon in the Weches. These specimens possess the shell characters described by Howe (see Howe and Chambers, 1935, p. 22) for the genus *Buntonia*. In a later study, Howe (see Howe and Law, 1936, p. 58) indicated the possibility that *Buntonia shubutaensis* Howe might be a molt of *Pyricythereis israelskyi* (Howe and Pyeatt) and its varieties. The shells of such young molts, when compared with the adults of the same species, are smaller, more fragile, and usually have more weakly developed ornamentation. In most instances the molts may be readily assigned to adult species, particularly after their ontogenetic relationships have been established with the isolation of the several molts often present. As it appears only to add nomenclatural confusion to recognize these molts as species they have been included with the adults. Unless it can be demonstrated that *Archicythereis* and *Buntonia* are adult genera distinct from other recognized genera it seems advisable to discontinue their use. Mature specimens of *Cythereis* are often common but usually of little value for correlation. Young molts of this and allied genera are of even more doubtful value and are usually too fragile to be preserved in subsurface material.

The shell characters described for *Navecythere* Coryell and Fields (1937, p. 7) suggest the strong probability that this form represents immature specimens. The small thin carapace lacks an interior marginal area and possesses a crenulate hinge structure, both features characteristic of molt stages of *Cythereis* and allied genera. It is fairly evident that the adult form of *Navecythere* is represented by the genus *Cativella* Coryell and Fields (1937, p. 9). This genus is characterized by a thick carapace of medium size, an inner margin, and a hinge similar to *Cythereis*. A careful comparative study of the two genotypes, *Navecythere delicata* and *Cativella navis*, should be undertaken before any more species are assigned to these genera. If the suspected relationship is demonstrated, the two forms represent a single genus which should be known as *Navecythere* because of page precedence.

The present study has necessitated an attempt at evaluating some of the genera most closely allied to *Cythereis*. Most species of this genus were classed under *Cythere* O. F. Müller (1785, p. 63) by earlier workers. *Cythereis* was erected as a subgenus under *Cythere* by Jones (1849, p. 14), and Baird (1850, p. 174) elevated it to generic status. Sars (1925, p. 192) noted that in an earlier paper on the Crustacea of Norway, he (Sars, 1865, p. 35) had supported *Cythereis* in the position of a genus distinct from *Cythere*. G. W. Müller (1894, p. 364) agreed with Sars that the two genera were distinct, although he attributed the genus *Cythereis* to Sars and placed *Cythereis* Jones in synonomy.

In erecting *Cythereis* as a subgenus, Jones (1849, p. 15) stated that the hinge was composed of the same elements present in "*Cythere* proper," and described it more fully as follows:

> The hinge-margin of the *right* valve is narrow and trenchant; its anterior extremity is suddenly produced into a conical tooth, having a slight cavity on its inner aspect; the posterior extremity affords a smaller process, of an oblong shape, accompanied by a slight cavity similar to the above. In the *left* valve the hinge-margin bears a slight groove along its surface of contact, and at each of its extremities is a semicircular or horseshoe-shaped cavity or socket for the reception of the hinge-teeth of the opposite valve.

Jones (1849, p. 9) described the hinge structure of *Cythere* in part as follows:

> In the right valve the ridge is next to the outer edge, and the furrow lies within the ridge; in the opposite valve the furrow lies just within the edge of the margin and the ridge on the inner side of the furrow. . . . The bars are narrow, rounded, polished, and finely crenulate or "knurled." The anterior and posterior extremities of these bars afford processes or teeth. . . .

The crenulate character of the terminal dentitions and of the hinge line between them was again brought out by Blake (1931) in his work on *Cythere lutea* O. F. Müller.

The genus *Hemicythere*, erected by Sars (1925, p. 182), was stated to occupy an intermediate position between *Cythere* and *Cythereis*. With hinge line and shell characters quite similar to *Cythereis*, it appears to be separable in the fossil state mainly on the basis of the outlines of the shell. Skogsberg (1928) wrote an exhaustive study on the genus *Cythereis*, based largely on material collected in the Antarctic. The genus was subdivided into *Cythereis*, the typical form, and the new subgenera *Procythereis* and *Pseudocythereis* were proposed. It appears impossible to distinguish these subgenera in fossil forms, as the shell characters are identical with those of *Cythereis*. *Pseudocythereis* Jennings (1936, p. 56), a homonym of Skogsberg's subgenus, has recently been renamed *Stephensonaria* (see Coryell, H. N.). With hingement identical with *Cythereis*, this genus from the Cretaceous of New Jersey was distinguished by differences in outline and overlap of the valves. *Paracythereis* Jennings (1936, p. 55) was noted to have an outline similar to *Cythereis*, but differed in the hinge structure. Examination of type material kindly forwarded by H. N. Coryell failed to produce specimens of these genera, and the types appear to be rare forms. The genus *Pyricythereis* Howe (see Howe and Law, 1936, p. 65) was given rather free treatment by Sutton and Williams (1939) in their study of Weches Ostracoda. The genus is used in a more restricted sense in this report, utilizing other shell characters in addition to the crenulate hinge. The genus *Protocythere*, erected by Triebel (1938), appears to exhibit all the shell characters typical of *Cythereis* with the exception of the hinge, which was noted to have strong notched terminal teeth with a connecting crenulate trench in the right valve, and corresponding sockets and bar in the left valve. *Campylocythere* and *Acuticythereis*, from the Miocene of North Carolina, were proposed by Edwards (1944, pp. 514, 519). These genera were distinguished principally on the shape of the anterior tooth of the hinge line. From this discussion it is apparent that a large number of genera, many of them little used, have been separated from what was originally included under the genus *Cythereis*.

The subgenus *Pterygocythereis* was erected by Blake (1933) to receive species with the hinge and other shell characters of *Cythereis*, but differing from it in the possession of alae. These two forms are readily separable, and in the writer's opinion *Pterygocythereis* should be elevated to generic rank, as typical species of *Cythereis* are rarely placed in the subgenus *Cythereis*. The genus *Brachycythere* was erected by Alexander (1933, p.

204) to include species strongly convex ventrally, this convexity at times developing into wing-like projections. The hinge line is distinct from *Cythereis* and *Pterygocythereis* in that the hinge bar of the right valve is below and distinct from the dorsal edge of the valve. These three genera seem to have been well defined.

The genus *Alatacythere* was proposed by Murray and Hussey (1942). It was described as possessing the alae of the genus *Pterygocythereis*, and a hinge structure similar to *Brachycythere*. The writer agrees with the authors of the genus in their contention that all of the finer details of shell structure must be examined to insure proper generic allocation. It seems necessary, however, that *each genus must possess one or more constant shell characters which shall in every case separate that genus from all others*. A study of the shell structure said to be diagnostic for *Alatacythere* has brought into focus the question as to which shell characters shall be indicative of the family, and which shall define the genus and species. In separating *Alatacythere* from *Brachycythere*, Murray and Hussey (1942, p. 164) observed that the muscle-scar pattern was diagnostic. In the writer's experience, the number and configuration of the muscle scars are rather similar for a family group of Ostracoda, and the same pattern may cross generic boundaries. The three patterns figured by Murray and Hussey (1942, text fig. 1, figs. 6, 7, 14) did not include the genotype, and all are different. The wide divergence between figures 7 and 14 indicates there is no well defined pattern for the genus. Minor differences in the number of radial pore canals exhibited by *Alatacythere* and *Brachycythere* are not convincing, and marginal ornamentation appears to be a specific rather than a generic character. The presence of or absence from the carapace of alae is a feature of generic rank, while their prominence appears to be a specific character. The alae of species assigned to *Alatacythere* range from weak to very strong.

Hinge structure is a definite generic criterion. While two or more genera may possess the same hingement, and be distinguished through other shell characters, the hinge line of any valid genus remains constant within rather narrowly defined limits. Murray and Hussey (1942, p. 169) defined the hinge of *Alatacythere* as follows:

> Hinge consists in right valve of an anterior S-shaped, slightly crenulate tooth posterior to which is a deep socket. A long, straight, finely crenulate groove extends backward from this socket. Posterior to the groove is an elongate, slightly arcuate, very strong, crenulate tooth. . . . In left valve, corresponding to the anterior tooth and postjacent socket of the right valve, is an anterior, somewhat S-shaped, slightly crenulate socket, immediately posterior to which is a strong, knob-like tooth. Extending backward from this to an elongate, arcuate, crenulate socket is a finely crenulate groove, the groove ending just anterior and dorsal to the posterior socket. Into this groove fits the raised, dorsal margin of the right valve.

I have a number of topotype specimens of *Pterygocythereis? alexanderi* Howe and Law (1936, p. 42), the genotype of *Alatacythere*. These specimens were taken from the same sample as that used by the authors of the genus, a sample collected by H. V. Howe from the lower part of the *Balanophyllia* bed of the Red Bluff Oligocene at Hiwannee, Mississippi. A study of this material indicates the above hinge description to be in error. The anterior dentition of the right valve consists of a knob-like tooth with a lower, smaller cusp just anterior and connected to it. This dentition is crenulate only in molt stages of the species. The groove behind the anterior socket is smooth in my specimens, and is confined dorsally by a smooth, narrow bar rather than the broad, crenulate ridge figured by the authors of the genus (pl. 27, fig. 10). In the left valve, no mention was made of a strong bar attached to the anterior tooth and extending backward from it to join the dorsal margin in front of the posterior socket. This bar articulates with the groove in the hinge line of the right valve, and is smooth in my material. Immediately above the bar and separating it from the dorsal margin is a narrow, smooth trench which is more prominent toward the posterior, where it is abruptly terminated just above and in front of the posterior socket. The hinge structure of the species was originally noted by Howe and Law (1936, p. 43) to be "similar to that of *Brachycythere* rather than that of *Cythereis* . . . ," and I find that the hingement of my specimens is entirely typical of the genus *Brachycythere* Alexander. In view of

these facts, it is recommended that the use of *Alatacythere* Murray and Hussey be discontinued until and unless it can be redefined and restricted in such a manner that it may be distinguished from existing valid genera.

The present study is an attempt to describe more accurately and completely the Weches Ostracoda. The fauna described includes only species identified in the exposures at Smithville. The accompanying check list indicates that some species appear to be restricted to only a portion of the exposure, although additional study of subsurface faunas and material from other surface localities will be necessary to determine ranges completely. All species identified in the Tyus member extend into the overlying Viesca. Forms which were found to extend upward into the lower portion of the Viesca include *Bairdia* sp., *Eucytherura claibornensis*, *Cytheretta tyusensis*, *Haplocytheridea ellisi*, *Clithrocytheridea garretti*, and *Cythereis splendens*. The several species of *Cytherura* are rare in Viesca samples. *Clithrocytheridea wechesensis* was identified extending into the lower portion of the Viesca, where it is replaced by an allied species, *C. subpyriformis*. *Paracytheridea palmerae* and *Cythereis claiborniana* were found only in the upper Viesca. Species originating in the upper Viesca which likewise occur in the Therrill member include *Brachycythere hadleyi*, *Cythereis therrillensis*, and *C. viescana*.

SYSTEMATIC DESCRIPTIONS

Order OSTRACODA Latreille

Suborder PLATYCOPA Sars

Family CYTHERELLIDAE Sars, 1865

Genus CYTHERELLA Jones, 1849

Cythere (*Cytherella*) Jones, (part), 1849, A Monograph of the Entomostraca of the Cretaceous formation of England, p. 28.

Cytherella Bosquet, (part), 1850 (1852), Description des entomostracés fossiles des terrains tertiaires de la France et de la Belgique: Acad. royale sci. Belgique, Mem., vol. 24, p. 9. Alexander, C. I., 1929, Univ. of Texas Bull. 2907, p. 47.

Genotype: *Cytherina ovata* Roemer, 1840, Verstein. Kreid., no. 4, p. 104, pl. 16, fig. 21. (Subsequent designation, Ulrich, E. O., 1894, in Geology of Minnesota, vol. 3, pt. 2, p. 684.)

CYTHERELLA sp.

Plate 42, figures 8, 9

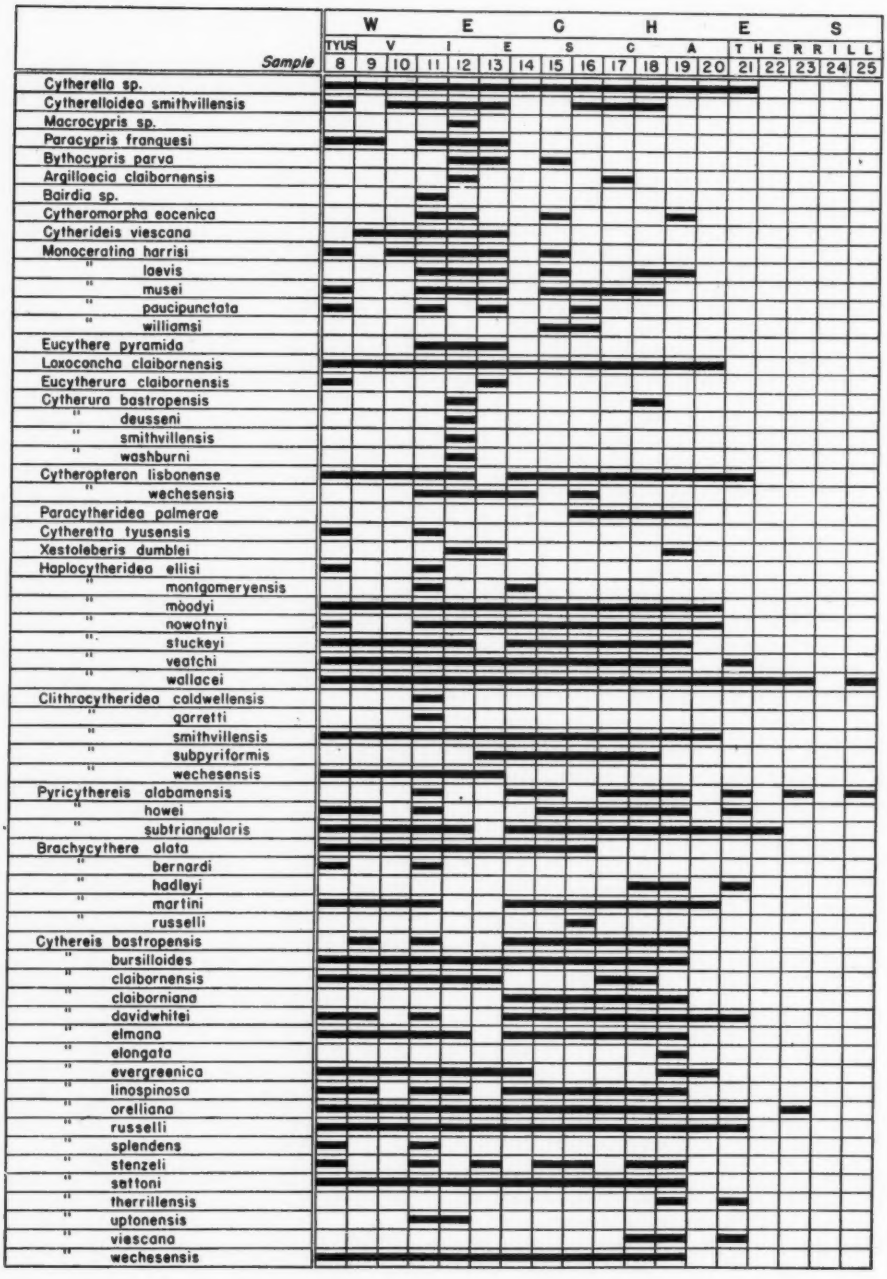
Cytherella texana Stadnichenko, 1927, Jour. Paleontology, vol. 1, p. 242, pl. 39, fig. 18.

Cytherella fimbricinctus Sutton and Williams, 1939, idem, vol. 13, p. 562, pl. 64, figs. 14, 15.

Cytherella sp. Stephenson, 1944, idem, vol. 18, p. 449.

Specimens of the genus *Cytherella* are not uncommon in the Weches. They are readily separable into two groups on the basis of shape, a factor believed to be due to sexual differences within a single species. Alexander (1932) has pointed out that sexual dimorphism is most pronounced in the family Cytherellidae, and indicated the shell characters identifying the male and female. His conclusions are in accord with those of van Veen (1928), who distinguished male and female carapaces of species of *Cytherelloidea*. The Weches species of *Cytherella* was defined and figured by Sutton and Williams (1939) from two valves of a female carapace. Numerous single valves and occasional complete specimens of both sexes occur in my material. The male (pl. 42, fig. 8) is elongate ovate, with ends well rounded and dorsal and ventral sides gently convex, subparallel in the smaller left valve. The right valve is slightly longer than left, showing moderate overlap on dorsal and ventral sides. The female (pl. 42, fig. 9) is ovate, longer, higher, and more strongly inflated posteriorly than the male, with the right valve strongly overlapping the left on dorsal and ventral sides.

The species described from the Cook Mountain (so-called Yegua) formation of Texas by Stadnichenko (1927, p. 242) as *C. texana* was described as being ". . . very small, ovate, thin, smooth, biconvex, compressed. . . ." Cook Mountain specimens from the Evergreen Crossing locality of Stadnichenko are nearly as large as those from the Weches, and it thus seems very probable that Stadnichenko's species was described and figured from a carapace in one of the molt stages. On the basis of shape and overlap, the only two evident criteria for separating these unornamented forms, it appears that *C.* sp. Stephenson, *C. fimbricinctus* Sutton and Williams, and *C. texana* Stadnichenko are all representatives of the



OCCURRENCE OF WECHES OSTRACODA AT SMITHVILLE, TEXAS

same species in the Reklaw, Weches, and Cook Mountain formations of the Claiborne Eocene of Texas. As it appears impossible to distinguish this species from numerous representatives of the genus in other Tertiary strata, the Weches form has not been specifically identified.

Length (male) 0.64 mm., height 0.39 mm., width 0.28 mm. Length (female) 0.74 mm., height 0.50 mm., width 0.35 mm.

Figured specimens.—No. 3323 (male), no. 3324 (female), from sample 4.

Genus CYTHERELLOIDEA Alexander, 1929

Cytherelloidea Alexander, C. I., 1929, Univ. of Texas Bull. 2907, p. 55.
Genotype: *Cytherella williamsoniana* Jones, T. R., 1849, Entomostraca of the Cretaceous formation of England: Paleont. Soc., Mon., p. 31, pl. 7, figs. 26, a–i.

CYTHERELLOIDEA SMITHVILLENSIS Howe
Plate 42, figures 10, 11

Cytherelloidea smithvillensis Howe, 1934, Jour. Paleontology, vol. 8, p. 30, pl. 5, fig. 3.
Cytherelloidea bastropensis Howe, 1934, idem, vol. 8, p. 31, pl. 5, fig. 12.

Carapace subquadrate, with valves shallow and compressed. Right valve larger than left, overlapping around entire periphery. Dorsal and ventral margins straight and horizontal. Anterior end broadly and evenly rounded; posterior end of same height, more bluntly rounded. A thickened, well elevated vertical ridge near posterior end continues as lower peripheral ridges around dorsal and ventral sides and anterior end. A sinuated horizontal ridge extends across center of carapace and arcs downward at its middle. Between this and the ventral rim is another horizontal ridge extending from the posterior ridge to about one-fourth the shell length from the anterior. Upper half of carapace excavated, with a pronounced depression at center. Hinge simple.

Length 0.57 mm., height 0.35 mm., width 0.25 mm. Length (right valve) 0.59 mm., height 0.35 mm. Length (left valve) 0.57 mm., height 0.31 mm. Length (molt valve) 0.40 mm., height 0.24 mm.

Remarks.—This species, described by Howe (1934) from the Weches at Smithville, is rather rare in most of the exposure. It does not occur in the author's collections from the Reklaw and Cook Mountain formations of Texas. Occasional specimens found in the Weches are identical with the form described by Howe (1934) as *C. bastropensis*. Such a specimen is herein illustrated (pl. 42, fig. 10). The carapace is smaller and more fragile, with a less strongly developed pattern of surface ornamentation than the typical form of *C. smithvillensis*. These specimens I consider molt valves, the adult form of which is seen in *C. smithvillensis*.

Types.—Hypotypes, no. 3325 (adult), from sample 4; no. 3326 (right valve), no. 3327 (left valve), no. 3328 (molt valve), from sample 3.

Suborder PODOCOPA Sars
Family CYPRIDAE Baird, 1846
Genus MACROCYPRIS Brady, 1868

Macrocypris Brady, G. S., 1868, Synopsis of Recent British Ostracoda: in Intellectual Observer London, vol. 12, p. 119.
Genotype: *Cythere minna* Baird, W., 1850, Natural History of the British Entomostraca, p. 171, pl. 20, fig. 4.

MACROCYPRIS sp.
Plate 43, figure 1

The very rare occurrence of a species referable to *Macrocypris* was noted in the Weches material. The carapace is low and elongate, and the exterior is entirely smooth. It is more fragile, lower, less inflated, and less steeply truncated on the posterior than *Argilloecia claibornensis*, n. sp. It seems inadvisable to name the form because of insufficient material.

Length (left valve) 0.48 mm., height 0.19 mm.

Figured specimen.—No. 3329 (left valve), from sample 12.

Genus PARACYPRIS Sars, 1865

Paracypris Sars, G. O., 1865, Oversigt af Norges marine Ostracoder: Videnskselsk. Oslo Forh. p. 11.
Genotype: *Paracypris polita* Sars, G. O., 1865, idem, p. 12.

PARACYPRIS FRANQUESI Howe and Chambers
Plate 42, figure 4; plate 44, figure 11

Paracypris franquesi Howe and Chambers, 1935, Louisiana Dept. Cons. Geol. Bull. 5, p. 10, pl. 3, fig. 13; pl. 4, figs. 15, 19. Bergquist, 1942, Mississippi Geol. Survey Bull. 49, p. 105, pl. 11, fig. 4.

Carapace large, in side view long, strongly tapering posteriorly. Dorsal margin weakly arched, sloping gently to posterior; ventral margin slightly indented. Anterior end high, obliquely rounded; posterior end narrow, tapering to acute postero-ventral angle. Surface smooth. Inner marginal areas (pl. 44, fig. 11) broad, with line of concrescence inside inner margin and near outer margin on anterior and posterior. A moderate number of radial pore canals are present, some bifurcating, and line of concrescence tends to be indented at canals. Muscle scar area nearly circular. Hinge simple, with a bar in right valve fitting into a groove in left valve.

Length (right valve) 1.09 mm., height 0.40 mm. Length (left valve) 1.12 mm., height 0.42 mm.

Remarks.—Weches specimens of this species appear to be typical, although the anterior cardinal angulation is slightly less pronounced than that exhibited by topotypes from the lower Jackson Eocene, one-fourth mile west of Water Valley, Alabama. Howe and Chambers (1935, p. 3) noted occurrences in the Jackson from Louisiana, Mississippi, and Alabama, and Bergquist (1942) likewise reported the species from the Jackson of Mississippi. The Weches specimens constitute the oldest recorded occurrence of the species.

Types.—Hypotypes, no. 3330 (right valve), no. 3331 (left valve), from sample 3.

Genus ARGILLOECIA Sars, 1865

Argilloecia Sars, G. O., 1865, Oversigt af Norges marine Ostracoder: Vidensk selsk. Oslo Forh., p. 17.
Genotype: *Argilloecia cylindrica* Sars, G. O., 1865, idem, p. 18.

ARGILLOECIA CLAIBORNENSIS Stephenson, n. sp.
Plate 43, figure 3

Carapace small, in side view low, elongate, highest at about the middle. Anterior end low, obliquely rounded; posterior end rather steeply sloping to the narrowly rounded posteroventral angle. Dorsal margin moderately well arched; ventral margin nearly straight, slightly sinuated, rising near the posterior. Surface smooth. Hinge structure simple, with dorsal edge of smaller left valve fitting into groove in edge of right valve. Calcified portion of inner lamella, which is broad in members of this genus, is not preserved.

Length (left valve) 0.46 mm., height 0.21 mm.

Remarks.—This species is similar to *A. subcylindrica* Alexander (1934a, p. 214, pl. 32, fig. 17; pl. 35, fig. 16) from the Midway Eocene of Texas. *A. claibornensis* is lower on the anterior end, is more strongly arched dorsally, and more bluntly pointed on the posterior. It is rare in the Weches at Smithville. A more complete treatment of the shell characters of the genus is given by Alexander (1934a, p. 213; 1935, p. 356).

Types.—Holotype, no. 3332, from sample 3.

Family BAIRDIIDAE Sars, 1887
Genus BAIRDIA McCoy, 1844

Bairdia McCoy, F., 1844, Carboniferous limestone fossils of Ireland, p. 164.
Nesidea Costa, O. G., 1847 (?), in Atti Acc. Pontan., vol. 5, p. 183.
Genotype: *Bairdia curta* McCoy, F., 1844, idem.

BAIRDIA sp.
Plate 42, figure 7

Rare specimens of a single species of *Bairdia* were obtained from the Weches material. The species is distinguished by its ornamentation, the entire surface of the valves being covered with closely spaced, shallow, rather fine pits. The pitting is readily visible, and is much more pronounced than that of other Eocene species known to the author. Unfortunately no complete carapaces were found, and the overlap of left valve over the right could not be determined. Available specimens include two entire right valves and several fragments. It seems inadvisable to name the species with the limited material at hand.

Length (right valve) 0.66 mm., height 0.37 mm.

Figured specimen.—No. 3333, from sample 3.

Genus BYTHOCYPRIS Brady, 1880

Bythocypris Brady, G. S., 1880, Rep. Voy. *Challenger*, Zool., vol. 1, pt. 3, p. 45.
Genotype: *Bythocypris reniformis* Brady, G. S., 1880, idem, p. 46, pl. 5, figs. 1, a–l.

BYTHOCYPRIS PARVA Stephenson, n. sp.
Plate 43, figure 2

Carapace small, fragile, in side view sub-

pyriform. Left valve slightly larger than right, overlapping it on dorsal and ventral sides. Dorsal margin moderately arched, flattened along hinge line and sloping gently toward posterior; ventral margin nearly straight. Anterior end broadly and obliquely rounded; posterior end narrower, bluntly truncated to the roundly pointed posteroventral angle. Surface smooth. Hinge simple.

Length 0.49 mm., height 0.25 mm., width 0.19 mm.

Remarks.—This species is more angular and very much smaller than *B.? gibsonensis* Howe and Chambers (1935, p. 9, pl. 3, fig. 10) from the Jackson Eocene. The species is rare in the Weches, and its occurrence is restricted to oxidized, ferruginous samples.

Types.—Holotype, no. 3334, from sample 12.

Family CYTHERIDAE Baird, 1850
Genus CYTHEROMORPHA Hirschmann, 1901 (?)

Genotype: *Cythere fuscata* Brady, G. S., 1869, in Ann. Nat. History, ser. 4, vol. 3, p. 47, pl. 7, figs. 5–8.

CYTHEROMORPHA EOCENICA
Stephenson, n. sp.
Plate 43, figure 9

Carapace small, fragile, in side view low, elongate. Valves subequal, the right slightly lower at the posterocardinal angle. Dorsal margin nearly straight, very weakly arched, gently sloping toward posterior. Ventral margin straight, rising to the postero-ventral angle. Anterior end well rounded, somewhat produced below ventral margin, faintly rimmed. Posterior end lower, bluntly truncated to the narrowly rounded posteroventral angle. Valves moderately inflated, the surface closely covered with very fine, faintly impressed pits. Pits toward posterior arranged between several obscure, curvilinear ridges subparallel to periphery. In addition to the holotype, a single left valve is available for study, the hinge line of which is very slender and delicate. A very faintly impressed, elongate anterior socket is followed by a thin bar, with a small, knoblike tooth at the posterocardinal angle. The dorsal margin is expanded at the posterocardinal angle, with a narrow depression between it and the tooth. Marginal areas rather narrow, with line of concrescence near outer margin.

Length 0.41 mm., height 0.20 mm., width 0.15 mm.

Remarks.—This minute species is very rare in the Weches. *C. ouachitaensis* Howe and Chambers (1935, p. 44, pl. 5, fig. 8; pl. 6, figs. 4, 5), from the Jackson, is larger, higher in proportion to its length, with the pits more prominent and encased by a reticulate network of threadlike ridges. The initial reference to *Cytheromorpha*, usually attributed to Hirschmann in 1901, is not available to the author.

Types.—Holotype, no. 3335, from sample 4.

Genus CYTHERIDEIS Jones, 1856

Cythere (*Cytherideis*) (part) Jones, T. R., 1856, Tertiary Entomostraca of England: Pal. Soc. London, Mon., p. 46.
Cytherideis Jones, T. R., and Sherborn, C. D., 1889, Supplementary monograph of the Tertiary Entomostraca of England: Pal. Soc. London, p. 45.
Genotype: *Cytherideis subulata* Brady, G. S., 1868, Recent British Ostracoda: Trans. Lin. Soc., vol. 26, p. 454, pl. 35, figs. 43–46.

CYTHERIDEIS VIESCANA
Stephenson, n. sp.
Plate 43, figure 12

Carapace subcylindrical, in side view low, elongate. Valves subequal in length, the left overlapping the right along most of dorsal and ventral margins. Cardinal angles obscure, with the gently arched dorsal margin merging with the obliquely rounded, somewhat compressed anterior end and the more bluntly rounded posterior end. Ventral margin fairly straight, somewhat sinuated. Surface smooth, showing faint granulation under higher magnifications, with few faintly impressed pits marking positions of normal pore canals. Hinge of right valve consists of narrow, shelflike groove extending from midpoint of dorsal margin to posterocardinal angle. The dorsal margin forms a low bar above the groove. A raised rim occupies anterior half of dorsal margin, posterior end, and ventral edge. In the left valve, a smooth bar articulates with the groove in the right valve. A short, narrow groove, open to anterior, is visible on anterior portion of dorsal margin. Marginal area

fairly broad on anterior, narrow on posterior.

Length 0.64 mm., height 0.26 mm., width 0.24 mm.

Remarks.—*Cytherideis subaequata* (Ulrich) (1901, p. 116, pl. 16, figs. 1–4), from the Aquia Eocene of Maryland, a similar form, appears to be a higher, more ovate species. The new species is rare in the Viesca member of the Weches.

Types.—Holotype (complete specimen), no. 3336; paratypes, no. 3337 (right valve), no. 3338 (left valve). All specimens from sample 4.

Genus MONOCERATINA Roth, 1928

Monoceratina Roth, R., 1928, Jour. Paleontology, vol. 2, p. 16. Alexander, C. I., 1934, idem, vol. 8, p. 57.
Genotype: *Monoceratina ventrale* Roth, R., 1928, idem, vol. 2, p. 16, figs. 1, a–c.

Carapace elongate, subquadrate. Dorsal and ventral margins nearly straight, subparallel. Anterior end rounded; posterior end with a produced, compressed caudal process. Valves often divided into two lobes by a median vertical sulcus, with surface smooth or variously ornamented. A laterally projecting spine near ventral margin, strongly developed in most Paleozoic species, is reduced or entirely wanting in most Tertiary forms. Hinge structure simple, with a bar in the left valve and corresponding groove in right valve.

In erecting the genus, Roth (1928) placed it under the family Primitiidae. Detailed studies of Cretaceous species of the genus were later published by Alexander (1933, 1934), who considered it to belong to the family Cytheridae because of the presence of the caudal process. In describing the Oligocene species *M. youngi*, Howe and Lea (see Howe and Law, 1936, pp. 40, 41) noted the muscle scar pattern to consist of " . . . a subcentral, nearly vertical row of four small spots, the lower three being larger and slightly oblique." *M. laevis*, n. sp., possesses an additional scar (pl. 44, fig. 3) well removed and vertically situated above the group. Alexander (1934, p. 59) noted the apparent range of the genus to be Pennsylvanian to Oligocene. Kellett (1943, p. 627) extended

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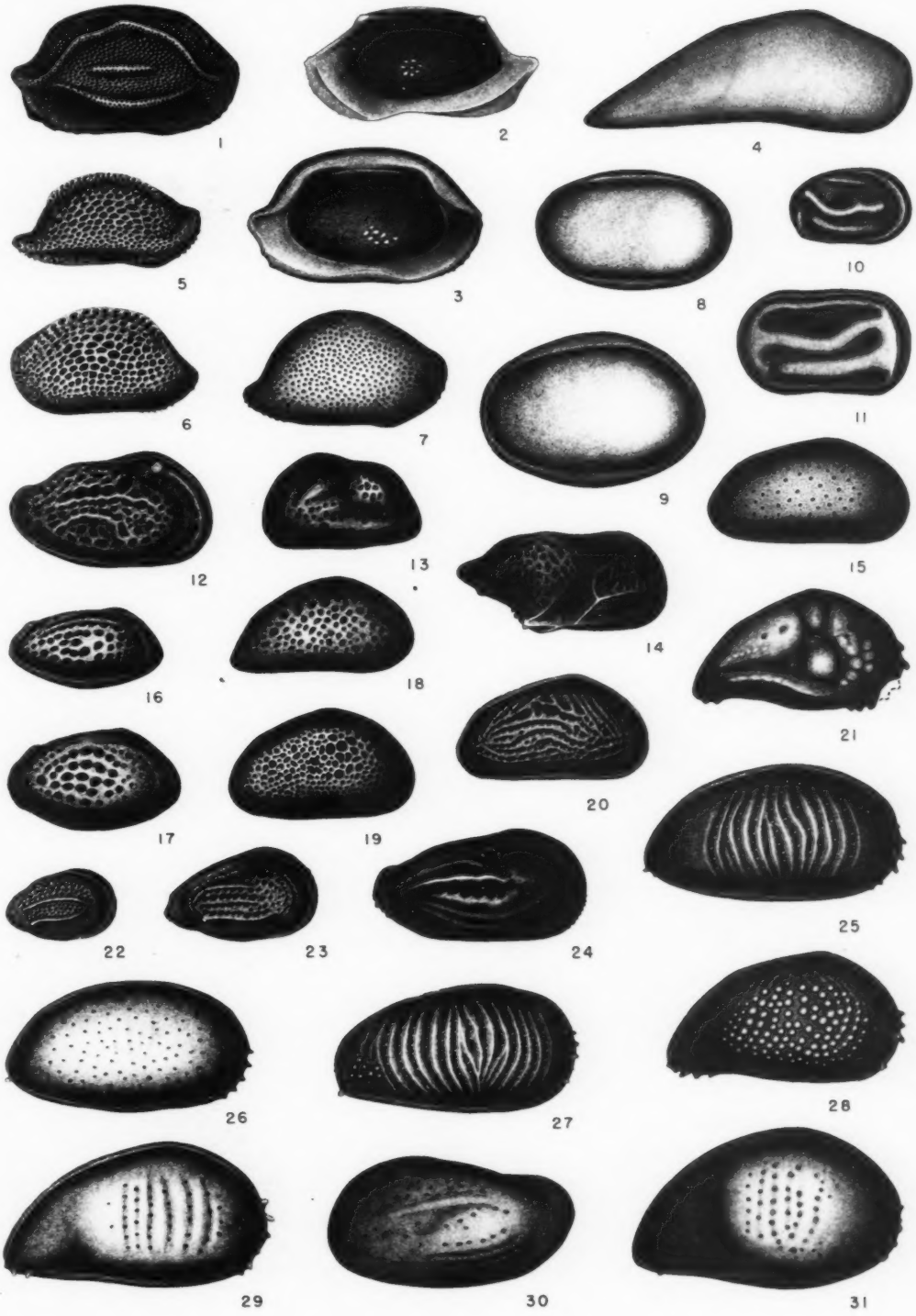
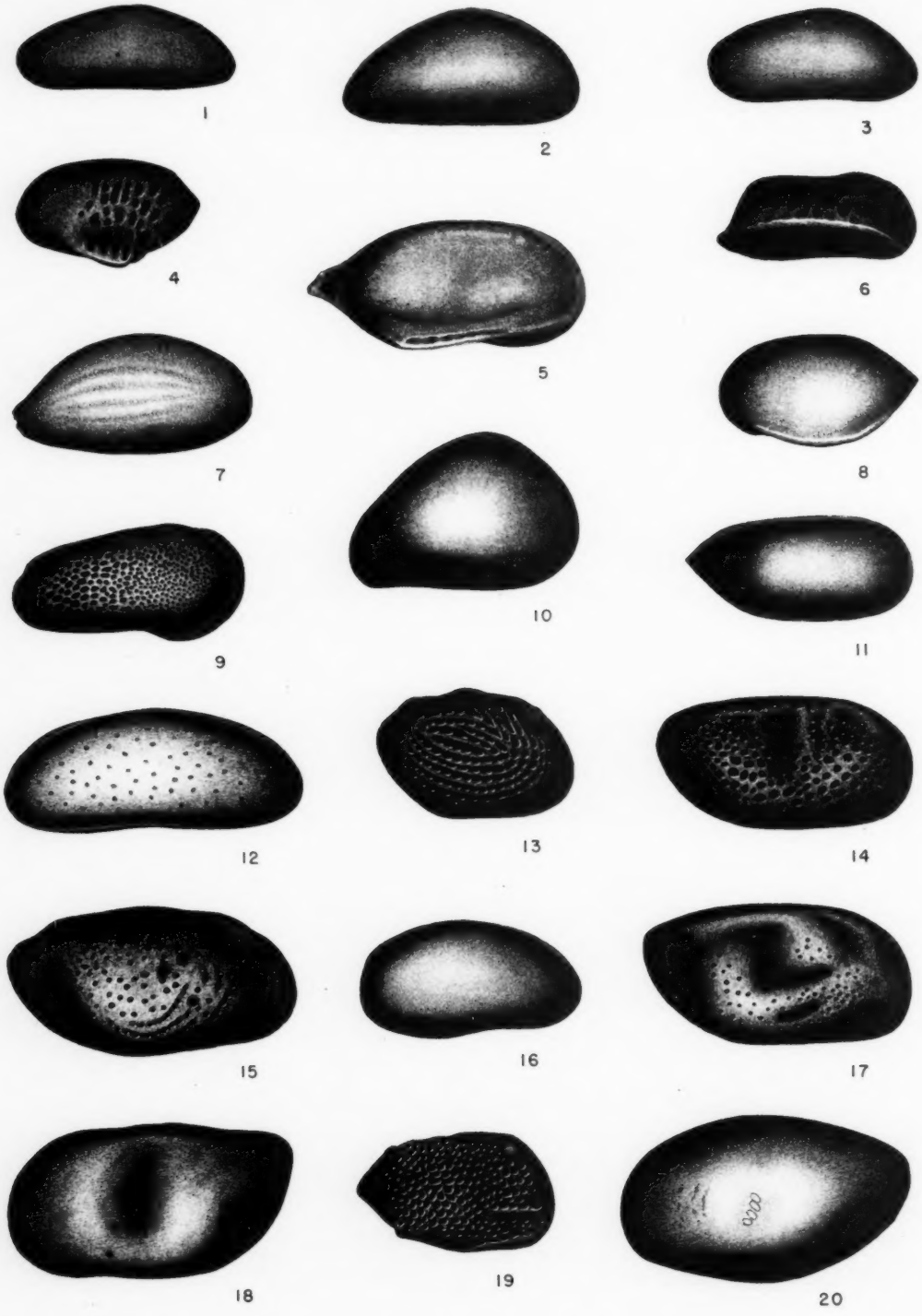
EXPLANATION OF PLATE 42

All figures ×45

FIGS. *1–3—Glyptobairdia bermudezi* Stephenson, n. sp. *1*, Right valve view. *2*, Interior of right valve. *3*, Interior of left valve. Recent, Cuba. (p. 346)
4—Paracypris franquesi Howe and Chambers. Right valve. Weches Eocene, Smithville, Texas. (p. 309)
5, 6—Glyptobairdia howei Stephenson, n. sp. *5*, Right valve. *6*, Left valve. Red Bluff Oligocene, Hiwannee, Mississippi. (p. 347)
7—Bairdia sp. Right valve. Weches Eocene, Smithville, Texas. (p. 310)
8, 9—Cytherella sp. *8*, Left valve view of male. *9*, Left valve view of female. (p. 307)
10, 11—Cytherelloidea smithvillensis Howe. *10*, Right valve of young molt. *11*, Left valve view of adult. (p. 309)
12—Pyricythereis alabamensis (Howe and Pyeatt). Right valve view of male. (p. 330)
13—Clithrocytheridea caldwellensis (Howe and Chambers). Left valve. (p. 327)
14—Paracytheridea palmerae Stephenson, n. sp. Right valve. (p. 319)
15—Clithrocytheridea smithvillensis Stephenson. Right valve view. (p. 327)
16, 17—Pyricythereis howei Stephenson, n. sp. *16*, Right valve view of male. *17*, Right valve view of female. (p. 330)
18—Clithrocytheridea garretti (Howe and Chambers). Right valve. (p. 327)
19—Clithrocytheridea wechesensis Stephenson. Right valve view. (p. 329)
20—Clithrocytheridea subpyriformis (Sutton and Williams). Right valve view. (p. 328)
21—Haplocytheridea ellisi Stephenson, n. sp. Right valve. (p. 322)
22–24—Pyricythereis subtriangularis Sutton and Williams. *22, 23*, Right valves showing molt stages. *24*, Right valve view of adult male. (p. 331)
25—Haplocytheridea moodyi (Howe and Garrett). Right valve view. (p. 323)
26—Haplocytheridea nowotnyi Stephenson, n. sp. Right valve view. (p. 324)
27—Haplocytheridea veatchi (Howe and Garrett). Right valve view. (p. 325)
28—Haplocytheridea wallacei (Howe and Garrett). Right valve view. (p. 325)
29—Haplocytheridea montgomeryensis (Howe and Chambers). Right valve view. (p. 322)
30—Cytheretta tyusensis Stephenson, n. sp. Left valve. (p. 320)
31—Haplocytheridea stuckeyi Stephenson, n. sp. Right valve view. (p. 324)



Stephenson – Weches Eocene Ostracoda



Stephenson – Weches Eocene Ostracoda

the lower range to Devonian. My collections contain specimens of an undescribed species from the Recent of the Gulf of Mexico which exhibit a delicate reticulate ornamentation and a pronounced acicular ventral spine. The known range of *Monoceratina* is therefore Devonian to Recent.

MONOCERATINA HARRISI Stephenson, n. sp.
Plate 43, figure 14

Carapace elongate, subquadrate. Dorsal and ventral margins subparallel, weakly convex. Anterior end broadly rounded; posterior end truncated to blunt caudal process at posterodorsal angle. Caudal process and posteroventral area compressed. A rather broad median vertical sulcus is visible on upper part of carapace. Remainder of shell wall moderately convex, with greatest inflation near posteroventral angle. Inflated portion of carapace rather closely covered with ovoid pits of moderate size and depth, the area between pits standing in relief as a reticulate pattern of ridges. Ornamentation becomes obscure toward periphery.

Length (right valve) 0.56 mm., height 0.28 mm.

Remarks.—The species differs from *M. umbonata* (Williamson) of Alexander (1934, p. 62, pl. 8, fig. 9) from the Cretaceous of Texas in lacking the strong spine and acute caudal process, and the pits are larger and more strongly impressed.

Named for Gilbert D. Harris for his splendid work on the Claiborne Pelecypoda.

Types.—Holotype, no. 3339 (right valve), from sample 6.

MONOCERATINA LAEVIS
Stephenson, n. sp.
Plate 43, figure 20; plate 44, figure 3

Carapace in side view elongate, subquadrate. Dorsal margin moderately arched, highest anterior to middle and sloping gently to posterior. Ventral margin convex, rising strongly toward posterior. Anterior end broadly and obliquely rounded; posterior end narrower, tapering to the blunt caudal process at posterodorsal angle. Anterior and posterior ends somewhat compressed, remainder of valves strongly and evenly convex, with greatest inflation somewhat posterior and ventral to center of carapace. Surface smooth, some specimens showing several low, obscure ridges subparallel to ventral margin on ventral slope of inflated portion of shell wall, with faintly impressed pits between ridges.

Length (right valve) 0.63 mm., height 0.32 mm. Length (left valve) 0.63 mm., height 0.35 mm.

Types.—Syntypes, no. 3340 (right valve), no. 3341 (left valve), from sample 5.

MONOCERATINA MUSEI Stephenson, n. sp.
Plate 43, figure 17

Carapace in side view elongate, subquad-

EXPLANATION OF PLATE 43

Figures ×70, unless otherwise indicated

FIGS. *1*—*Macrocypris* sp. Left valve. (p. 309)
2—*Bythocypris parva* Stephenson, n. sp. Right valve view. (p. 310)
3—*Argilloecia claibornensis* Stephenson, n. sp. Left valve. (p. 310)
4—*Cytheropteron lisbonense* Martin. Left valve. (p. 318)
5—*Cytherura washburni* Stephenson, n. sp. Right valve view. ×85. (p. 317)
6—*Cytherura deusseni* Stephenson, n. sp. Right valve. ×85. (p. 317)
7—*Cytherura bastropensis* Stephenson, n. sp. Right valve. ×85. (p. 317)
8—*Cytheropteron wechesensis* Stephenson, n. sp. Left valve. (p. 318)
9—*Cytheromorpha eocenica* Stephenson, n. sp. Right valve view. ×85. (p. 311)
10—*Eucythere pyramida* Stephenson, n. sp. Right valve view. (p. 314)
11—*Cytherura smithvillensis* Stephenson, n. sp. Right valve view. ×85. (p. 317)
12—*Cytherideis viescana* Stephenson, n. sp. Right valve view. (p. 311)
13—*Loxoconcha claibornensis* Murray. Right valve view. (p. 315)
14—*Monoceratina harrisi* Stephenson, n. sp. Right valve. (p. 313)
15—*Monoceratina paucipunctata* Stephenson, n. sp. Right valve. (p. 314)
16—*Xestoleberis dumblei* Stephenson, n. sp. Right valve view. ×85. (p. 320)
17—*Monoceratina musei* Stephenson, n. sp. Right valve. (p. 313)
18—*Monoceratina williamsi* Stephenson, n. sp. Left valve. (p. 314)
19—*Eucytherura claibornensis* Stephenson. Right valve. ×85. (p. 316)
20—*Monoceratina laevis* Stephenson, n. sp. Left valve. (p. 313)

rate. Dorsal and ventral margins slightly convex, subparallel, somewhat diverging toward posterior. Anterior end broadly and obliquely rounded; posterior end tapering to blunt caudal process at posterodorsal angle. Anterior end, caudal process and posteroventral area compressed. Central portion of shell fairly strongly convex, with greatest inflation near posteroventral angle. A rather deep, broad, median vertical sulcus on upper portion of shell is defined dorsally by a ridge arcing downward around its anterior side. Two more ridges extend a short distance to the anterior from a posteroventral inflation. The upper of these ridges outlines ths sulcus ventrally, and there is a short, deep depression separating them. Surface of shell fairly smooth, covered with very shallow, inconspicuous pits.

Length (right valve) 0.60 mm., height 0.31 mm. Length (left valve) 0.57 mm., height 0.29 mm.

Named for Victor E. Muse, geologist, Stanolind Oil and Gas Company, Lander, Wyoming.

Types.—Syntypes, no. 3342 (right valve), no. 3343 (left valve), from sample 2.

Monoceratina paucipunctata
Stephenson, n. sp.
Plate 43, figure 15

Carapace in side view elongate, subquadrate. Dorsal and ventral margins subparallel, very weakly convex. Anterior end broadly and obliquely rounded; posterior end curved upward to short, blunt caudal process just below posterocardinal angle. Anterior and posterior ends and ventral margin compressed. Remainder of shell strongly convex, with the inflated shell wall overhanging the strongly compressed ventral area. Eyespot faintly visible, with shallow depression posterior to it. Inflated portion of carapace shows numerous small shallow pits. On ventrally overhanging inflation, pits are aligned between obscure ridges subparallel to ventral margin. Pitting becomes obscure toward periphery.

Length (right valve) 0.63 mm., height 0.32 mm.

Remarks.—This species differs from *M. laevis*, n. sp., in being pitted over most of the surface, and in being more weakly inflated dorsally, with shell strongly overhanging toward the ventral margin.

Types.—Holotype, no. 3344 (right valve), from sample 3.

Monoceratina williamsi
Stephenson, n. sp.
Plate 43, figure 18

Carapace in side view subquadrate. Dorsal and ventral margins parallel, nearly straight. Anterior end broadly and evenly rounded; posterior end descending obliquely from the bluntly produced posterior caudal process. Anterior end, posteroventral area and caudal process compressed. A fairly deep median vertical sulcus extends from a point near the dorsal margin to the center of the shell, dividing the carapace into two subequal lobes. Shell smooth, faintly granular under higher magnifications. Hinge typical for genus.

Length (left valve) 0.60 mm., height 0.33 mm.

Remarks.—The new species somewhat resembles *M. acanthoptera* (Marsson) of Alexander (1934, p. 61, pl. 8, fig. 6), from the Cretaceous of Texas. *M. williamsi* has a narrower vertical sulcus with stronger inflation anterior and posterior to it. The new species shows some inflation, but no hornlike spine on the posterior lobe.

Named for John R. Williams for his work on the Weches Ostracoda.

Types.—Holotype, no. 3345 (left valve), from sample 5.

Genus Eucythere Brady, 1868

Cytheropsis Sars, G. O. (*not* McCoy, 1855), 1865, Oversigt af Norges marine Ostracoder: Vidensk selsk. Oslo Forh., p. 57.

Eucythere Brady, G. S., 1868, A monograph of the Recent British Ostracoda: Lin. Soc. London, Trans., vol. 26, p. 429.

Genotype: *Cythere declivis* Norman, A. M., 1865, Nat. Hist. Soc. Northumb., Trans., vol. 1, p. 16, pl. 5, figs. 9–12. Synonym: *Cytheropsis tenuitesta* Sars, G. O., 1865, op. cit., p. 59.

Eucythere pyramida
Stephenson, n. sp.
Plate 43, figure 10; plate 44, figure 4

Carapace in side view triangular, highest at antero-cardinal angle. Left valve larger than right, overlapping around entire

periphery, with strongest overlap around antero-cardinal angle and along ventral margin. Dorsal margin nearly straight, steeply sloping to posterior. Ventral margin straight, with anterior portion somewhat produced below it in some specimens. Anterior end high, broadly and obliquely rounded; posterior end low, steeply truncated to the narrowly rounded posteroventral angle. Shell wall smooth, strongly and evenly convex, with greatest inflation somewhat posterior to middle. Hinge of right valve consists of a groove which is broadest at its anterior end, with the low dorsal margin above it. Narrow, slightly raised dental areas occupy the cardinal angles at each end of the groove. In the left valve (pl. 44, fig. 4) a bar is separated from the dorsal margin by a faintly depressed area. The bar is flanked at both ends by elongate sockets. Marginal areas moderately broad, with line of concrescence extending into marginal areas on anterior and posterior. Radial pore canals straight, about 8 to 10 on anterior. Muscle-scar pattern an oblique row of four small, ovoid scars, with another larger, crescentic scar anterior to the row.

Length 0.51 mm., height 0.34 mm., width 0.27 mm.

Remarks.—Alexander found two species of *Eucythere* from the Cretaceous (1936), and a single species from the Midway Eocene (1934a). Howe (1936) described three species from the Oligocene and Miocene. *E. pyramida* is a rare form in the Weches.

Types.—Holotype, no. 3346 (complete specimen), from sample 7; paratypes, no. 3347 (right valve), no. 3348 (left valve), from sample 5.

Genus LOXOCONCHA Sars, 1865

Loxoconcha Sars, G. O., 1865, Oversigt af Norges marine Ostracoder: Vidensk selsk. Oslo Forh., p. 61. Synonym: *Normania* Brady, G. S., 1866, in Zool. Soc. London, Trans., vol. 5, p. 382.

Genotype: *Loxoconcha bairdi* Müller, G. W., 1912, Das Tierreich, p. 306, fig. 85. Synonyms: *Cythere impressa* Baird, W. (*not* McCoy, 1847), 1850, British Entomostraca, p. 173; *Loxoconcha rhomboidea* Sars, G. O., 1865, *op. cit.*, p. 62.

LOXOCONCHA CLAIBORNENSIS Murray

Plate 43, figure 13

Loxoconcha claibornensis Murray, 1938, Jour. Paleontology, vol. 12, p. 588, pl. 68, figs. 2, 19.

Pyricythereis delicata Sutton and Williams, 1939, idem, vol. 13, p. 568, pl. 64, figs. 5–7.

Loxoconcha delicata (Sutton and Williams). Stephenson, 1944, idem, vol. 18, p. 454, pl. 76, fig. 10.

Carapace rather small, in side view subrhomboidal. Valves subequal in length, the left overlapping the right on dorsal and ventral margins, with greatest overlap at posterocardinal angle. Dorsal margin straight with slight convexity at midpoint; ventral margin somewhat convex, rising posteriorly to caudal process. Anterior end broadly and obliquely rounded; posterior end compressed, tapering to blunt caudal process above median height of shell. Surface covered with rather small pits tending to be aligned between low, rounded ridges subparallel to periphery, with ridges somewhat coalesced around pits. A slightly more pronounced arcuate ridge is present near ventral margin on some specimens. Hinge in right valve with anterior socket followed by a knoblike tooth, then a crenulate trench to the narrow, arcuate posterior dentition. In left valve, hinge with knoblike anterior tooth and postjacent socket, followed by a slender bar to posterior socket, with shell margin expanded around socket. Line of concrescence extends into marginal area on anterior and posterior; pore canals few. Muscle-scar pattern obscured by surface ornamentation.

Length 0.43 mm., height 0.27 mm., width 0.22 mm.

Remarks.—The name of the genotype of *Loxoconcha*, described as *Cythere impressa* by Baird (1850), was a homonym of a form defined by McCoy three years earlier. Müller (1912) pointed out the error, and renamed the type species *L. bairdi*, a fact which was overlooked by Murray (1938, p. 587) in his study of the genus.

Weches specimens of *L. claibornensis* have been compared with topotypes collected by me from the Lisbon formation at Claiborne Bluff on Alabama River, Alabama. As was indicated in the original description, the species is somewhat variable, and it appears impractical to attempt any separation. The hinge structure of my material appears simpler than that described by Murray (1938, p. 588) for the species, but agrees well with the hingement defined for the genus by

Alexander (1934a, p. 227). The species occurs, usually rather commonly, throughout the more fossiliferous portion of the Weches, and is likewise present in my collections from the Reklaw and Cook Mountain formations of Texas. Molt valves are rare. Those found show very fine pits with complete absence of ridges between them. Due to its rather generalized ornamentation and similarity to other forms, it is of little value for correlation.

Types.—Hypotypes, no. 3349 (complete specimen), no. 3350 (right valve), and no. 3351 (left valve). All specimens are from sample 3.

Genus EUCYTHERURA Müller, 1894

Eucytherura Müller, G. W., 1894, Fauna und Flora des Golfes von Neapel, Mon. 21, Ostracoden, p. 305.

Genotype: *Cythere complexa* Brady, G. S., 1867, Report on Ostracoda dredged amongst the Hebrides: Rep. Brit. Ass. Adv. Sci., p. 210.

EUCYTHERURA CLAIBORNENSIS Stephenson

Plate 43, figure 19

Eucytherura claibornensis Stephenson, 1944, Jour. Paleontology, vol. 18, p. 453, pl. 76, fig. 16.

The species was originally defined as follows:

Carapace small, subquadrate. Dorsal margin straight, sloping very gently toward the posterior, and subparallel to the slightly convex ventral margin. Anterior end rounded; posterior end bluntly angular, sloping abruptly and steeply from the prominent posterocardinal angle. Surface strongly sculptured, showing small, deep, closely spaced pits, which cover the entire exterior except for the short, blunt posterior caudal process, which is nude. A small elevated eyespot is visible. Shell wall compressed along the dorsal margin, with a depressed area extending through the central portion toward the ventral margin. Hinge structure similar to that in the genus *Cythereis*.

Length (right valve) 0.35 mm., height 0.20 mm.

Remarks.—This minute, highly ornamented species was described from the Reklaw formation of the Claiborne Eocene of Texas. The holotype, a broken right valve, did not show the characteristics of the posterior end. Two entire right valves that have a short, pointed, caudal process were obtained from the Weches. The hinge line of these right valves bears small, knoblike teeth at the cardinal angles. A narrow groove between them is almost imperceptibly crenulated. A slender bar defines the groove dorsally. Marginal areas are moderately broad, bearing only a few radial pore canals. The line of concrescence appears to coincide with the inner margin throughout.

In the original description of the genus *Eucytherura*, Müller (1894, p. 305) indicated the hinge of the right valve to consist of anterior and posterior teeth, with the hinge line between these teeth finely crenulated. The hinge structure of the Weches specimens thus corresponds closely to that originally described for the genus.

In addition to the Texas occurrences in the Reklaw and Weches formations, the species is present in the Midway Eocene at Matthews Landing on Alabama River, Wilcox County, Alabama. Midway specimens are somewhat smaller, but agree in all other shell characters.

Types.—Hypotype, no. 3352 (right valve), from sample 4.

Genus CYTHERURA Sars, 1865

Cytherura Sars, G. O., 1865, Oversigt af Norges marine Ostracoder: Vidensk selsk. Oslo Forh., p. 69. Müller, G. W., 1894, Fauna und Flora des Golfes von Neapel, Mon. 21, Ostracoden, p. 287.

Genotype: *Cythere gibba* Müller, O. F., 1785, Entomostraca, p. 66, pl. 7, figs. 7–9. Synonym: *Cythere gibbera* Müller, O. F., (male), 1785, idem, p. 66, pl. 7, figs. 10–12.

Shell small, elongate, subquadrate. Dorsal and ventral margins subparallel to somewhat convex. Anterior end broadly, usually obliquely rounded. Posterior end compressed, produced to a caudal process behind and usually a little below posterocardinal angle. Shell smooth to complexly ornamented, in some species with keellike lateral ridges, others exhibiting alaeform ventral expansions.

Species of this genus may be most readily determined by their shape, as the finer shell characters are difficult to study due to the small size of the shell. The hinge line was noted by Sars (1925, p. 199) to be "imperfectly developed." Müller (1894, p. 287) more adequately defined the hinge structure,

and amplified his description later (Müller, 1912, p. 263). The hinge of the right valve was stated to consist of two simple teeth. The left valve occasionally carries only one, but usually two teeth, one articulating just behind the anterior tooth and the other just in front of the posterior tooth of the opposite valve. The teeth of the right valve were noted to be larger than those of the left, although all may be wanting. The hinge line between the teeth was stated to be smooth. Müller (1894, p. 287) noted the inner margin and line of concrescence ("Verwachsungslinie") to coincide throughout, and showed (pl. 17, fig. 5) the characteristic expansion of the inner margin to form a lobe convex to the posterior end. This diagnostic feature was likewise illustrated by Sars (1925, pl. 94, fig. 1). The muscle-scar pattern is clearly shown on drawings of some species of Müller (1894) to consist of four elongate, ovoid scars, closely grouped in a vertical row, and at least one species, *Cytherura nigrescens* Müller (pl. 18, fig. 3) is shown to possess an additional three similar scars in a vertical row just anterior to the usual group of four. The muscle-scar area was not clearly drawn by Sars (1925, pl. 94), but appears to consist of a single vertical row of four scars.

CYTHERURA BASTROPENSIS
Stephenson, n. sp.
Plate 43, figure 7

Carapace in side view elongate, subquadrate. Dorsal margin moderately arched; ventral margin somewhat convex. Anterior end rounded; posterior end compressed, rapidly tapering to blunt, angular caudal process. Valves moderately and evenly inflated. Surface smooth except for variable number of very low, rounded horizontal ridges. Ornamentation becomes obscure toward periphery, and in some specimens is almost entirely absent.

Length (right valve) 0.40 mm., height 0.21 mm.

Types.—Holotype, no. 3353 (right valve), from sample 12.

CYTHERURA DEUSSENI Stephenson, n. sp.
Plate 43, figure 6

Carapace small, in side view subrhomboidal. Dorsal margin nearly straight, subparallel to slightly undulating ventral margin. Anterior end obliquely rounded; posterior end steeply sloping to short, compressed, blunt caudal process just above ventral margin. Shell wall rises rapidly from dorsal margin to pronounced longitudinal keel somewhat ventral to center of carapace. Keel starts from anteroventral angle, arcing upward and backward across shell wall, becoming obscure near posterior end. Carapace wall strongly excavated and steeply sloping from keel to ventral margin. Shell surface faintly irregular.

Length (right valve) 0.35 mm., height 0.15 mm.

Named for Alexander Deussen, for his work on the Smithville exposures.

Types.—Holotype, no. 3354 (right valve), from sample 12.

CYTHERURA SMITHVILLENSIS
Stephenson, n. sp.
Plate 43, figure 11

Carapace small, in side view elongate, subquadrate. Valves subequal, the left overlapping the right along dorsal slope of caudal process. Dorsal and ventral margins straight and parallel. Anterior end broadly and evenly rounded; posterior end somewhat compressed, rapidly tapering to acute caudal process slightly above midpoint of shell height. Surface smooth, faintly granular, moderately and evenly inflated, with greatest thickness posterior to middle.

Length 0.40 mm., height 0.19 mm., width 0.17 mm.

Types.—Holotype, no. 3355 (complete specimen), from sample 12.

CYTHERURA WASHBURNI
Stephenson, n. sp.
Plate 43, figure 5

Carapace small, in side view elongate, subquadrate. Valves subequal, the left slightly overlapping the right. Dorsal and ventral margins straight, subparallel. Anterior end broadly rounded; posterior end produced to strongly compressed, narrow, angular caudal process slightly above midpoint of shell height. Shell well inflated just in front of caudal process, slightly depressed through median area. Exterior nearly smooth, slightly irregular. A ventral alaeform projection has its inception near

anteroventral angle, becomes more prominent to a point somewhat posterior to middle, thence arcing upward and becoming obscure. Crest of projection is irregularly excavated. Three muscle scars are visible, in a vertical row somewhat anterior and ventral to center of carapace.

Length 0.47 mm., height 0.22 mm., width 0.25 mm.

Named for Carlton F. Washburn, who assisted in the collection of samples.

Types.—Holotype, no. 3356 (complete specimen), from sample 12.

Genus CYTHEROPTERON Sars, 1865

Cytheropteron (part) Sars, G. O., 1865, Oversigt af Norges marine Ostracoder: Vidensk selsk. Oslo Forh., p. 79. Müller, G. W., 1894, Fauna und Flora des Golfes von Neapel, Mon. 21, Ostracoden, p. 300.
Cytheropteron (*Cytheropteron*) Sars. Alexander, C. I., 1933, Jour. Paleontology, vol. 7, p. 181.
Genotype: *Cythere latissima* Norman, A. M., 1865, Nat. Hist. Soc. Northumberland, Trans., vol. 1, p. 19, pl. 6, figs. 5–8.

Carapace usually small, in side view subovate. Dorsal margin arched; ventral margin convex. Anterior end rounded; posterior end produced to form a compressed, often upturned caudal process. More or less prominent alaeform expansions of the valves near ventral margin are a characteristic feature. Hinge in right valve is equipped with elongate, taxodont dental areas at the cardinal angles, each divided into several cusps. Hinge margin between dentitions is formed by a notched trench. In left valve, notched terminal sockets are joined by a crenulate bar.

Sars (1925, p. 223) gave a very brief description of the shell characters of the genus, noted the hinge to be imperfectly developed, and emphasized the prominent alaeform lateral expansions of the shell wall. Müller (1894, p. 300) defined the crenulated hinge margin of the right valve and the muscle-scars arranged in a row of four, with rarely a fifth scar anterior to them. The line of concrescence was described as coinciding with the inner margin except on the anterior, where it extends into the marginal area. Alexander (1933) gave a detailed description of the genus, and restricted it by erecting *Eocytheropteron*. He (Alexander, 1933, p. 189) noted that Lienenklaus (1894, p. 243) had described a vertical row of four muscle scars with usually one in front of them, and stated he had noted two scars anterior to the row in some Cretaceous species.

CYTHEROPTERON LISBONENSE Martin
Plate 43, figure 4

Cytheropteron lisbonense Martin, 1939, Jour. Paleontology, vol. 13, p. 177, pl. 22, figs. 1–3.
Cytheropteron minutum Sutton and Williams, 1939, idem, vol. 13, p. 573, pl. 64, figs. 8–10.

Carapace small, in side view subovate. Valves subequal in length, the left overlapping the right along dorsal and ventral margins. Dorsal margin strongly arched between weak cardinal angles; ventral margin somewhat less strongly convex. Anterior end rather narrowly and obliquely rounded; posterior end slightly compressed and tapering to the short, blunt, rounded caudal process at about midpoint of shell height. Valves moderately inflated, their central areas showing several rather irregular, low, slender, vertical ribs with branching riblets between them, forming a pattern of shallow depressions. Ventral ala rather weakly developed, with rounded crest, and extending across about central half of carapace.

Length 0.41 mm., height 0.26 mm., width 0.24 mm. Length (right valve) 0.34 mm., height 0.23 mm. Length (left valve) 0.40 mm., height 0.23 mm.

Remarks.—This minute species was described from the Lisbon formation at Claiborne Bluff, Alabama. Martin (1939, p. 181) reported additional occurrences from the Cane River of Louisiana, the Cook Mountain at Evergreen Crossing, Texas, and the Weches at Smithville. Weches specimens are entirely typical, although they tend to be somewhat more weakly ornamented than topotypes collected by me.

Types.—Hypotypes, no. 3357 (complete specimen), from sample 4; no. 3358 (right valve), no. 3359 (left valve), from sample 3.

CYTHEROPTERON WECHESENSIS
Stephenson, n. sp.
Plate 43, figure 8

Carapace minute, in side view subovate. Dorsal margin weakly to moderately arched, subparallel to the slightly convex ventral margin. Anterior end broadly rounded; pos-

terior end tapering to the short, often somewhat upturned caudal process at about midpoint of shell height. Ventral ala weak, partially obscuring ventral margin. Ala in form of low ridge starting from near anterior end at point slightly above ventral margin and extending in a gently down-curved arc becoming obscure near caudal process. No spinelike projection of ala present. Surface of valves smooth, although occasional specimens show a very faint, almost imperceptible reticulate pattern.

Length (right valve) 0.38 mm., height 0.22 mm. Length (left valve) 0.43 mm., height 0.24 mm.

Remarks.—This species is longer and less ovate than *C. lisbonense*, showing weaker alae, and ornamentation is virtually lacking. *C. variosum* Martin (1939, p. 178, pl. 22, figs. 7–9) is higher on the anterior, with a more strongly arched dorsal margin, and is usually ornamented. *C. midwayensis* Alexander (1934a, p. 230, pl. 33, fig. 17) from the Midway Eocene possesses no ridgelike development of the alaeform expansions.

Types.—Syntypes, no. 3360 (right valve), from sample 4; no. 3361 (left valve), from sample 6.

Genus PARACYTHERIDEA G. W. Müller, 1894

Paracytheridea Müller, G. W., 1894, Fauna und Flora des Golfes von Neapel, Mon. 21, Ostracoden, p. 340.

Genotype: *Cytheropteron bovettensis* Seguenza, G., 1880, in Atti Acc. lincei Mem., ser. 3, vol. 6, p. 365, pl. 17, fig. 54. Synonym: *Paracytheridea depressa* Müller, G. W., 1894, op. cit., p. 341, pl. 26, figs. 16–26; pl. 29, figs. 4, 8.

PARACYTHERIDEA PALMERAE Stephenson, n. sp.

Plate 42, figure 14; plate 44, figure 19

Carapace in side view elongate, triangular, highest at anterocardinal angle. Dorsal margin nearly straight, somewhat indented. Ventral margin very weakly convex, in part obscured by ala. Anterior end broadly rounded, compressed, faintly rimmed. Posterior end compressed, subacute, gently tapering to the angular, bluntly pointed caudal process. Each valve bears a strong ala which terminates in an irregular, sculptured, pointed ventral spine at about one-third the shell length from the posterior. Axis of ala is directed somewhat toward posterior. A keellike ridge in front of the spine bifurcates at about one-third the shell length from anterior, one segment forming an arc upward and forward across the anterior inflation, the other continuing near the ventral margin and curving gently upward. A depression extends obliquely downward from vicinity of anterior cardinal angle toward ventral spine, with an expansion anterior and ventral to it, and another lesser inflation posterior and dorsal to it. Surface ornamented with a pattern of low, anastomosing ridges. Hinge structure of right valve consists of slightly raised, faintly notched terminal dentitions at the cardinal angles, with a crenulate groove between them. In the left valve, hinge possesses weak, notched sockets joined by a faintly crenulate bar. Marginal zones rather narrow, with line of concrescence coinciding with inner margin.

Length (right valve) 0.67 mm., height 0.32 mm., width 0.26 mm.

Remarks.—The new species is similar to *P. belhavenensis* Howe and Chambers (1935, p. 18, pl. 5, fig. 9) from the Jackson Eocene. The Weches species is much lower in side view, with the ventral spine more erect, and more obscure ornamentation. Most Jackson specimens show strongly sculptured nodes on the posterior inflation.

The muscle scars on this species are obscured by surface ornamentation. Müller (1894, pl. 29, fig. 4) showed at least three vertically situated scars with one additional scar anterior to them on the genotype. Other scars may be hidden by exterior sculpturing.

Named for Katherine Van Winkle Palmer, for her work on the Mollusca at Gasley Creek.

Types.—Holotype, no. 3362 (right valve), from sample 7.

Genus CYTHERETTA Müller, 1894

Cytheretta Müller, G. W., 1894, Fauna und Flora des Golfes von Neapel, Mon. 21, Ostracoden, p. 382.

Pseudocytheretta Cushman, J. A., 1906, Boston Soc. Nat. History Proc., vol. 32, no. 10, p. 382.

Genotype: *Cytheretta rubra* Müller, G. W., 1894, op. cit., p. 382, pl. 8, figs. 9, 10, 13, 16; pl. 39, figs. 8–22, 24.

CYTHERETTA TYUSENSIS
Stephenson, n. sp.
Plate 42, figure 30; plate 44, figure 20

Carapace in side view elongate, subovate. Dorsal margin gently arched in right valve, sinuate in left with prominent posterocardinal angle. Ventral margin slightly sinuate in right valve, convex and rising rapidly toward posterior in left. Anterior end broadly rounded; posterior end narrower, bluntly truncated. Valves well inflated, with faintly visible eyespot. Surface fairly smooth with several very weak horizontal ridges, between which are a number of irregularly disposed pits. Hinge structure similar to that in the genus *Cythereis*. In the right valve, hinge consists of a strong anterior S-shaped tooth, with postjacent deep socket connecting with a trench which is finely crenulate, and joins the strong, knoblike posterior tooth. In left valve, a large, well excavated anterior socket is followed by a raised swelling which joins a narrow, well raised bar which is distinctly and finely notched. The bar is abruptly truncated into the ovoid posterior socket, with shell margin as a rim around it and raised above the general dorsal margin. Anterior marginal area (pl. 44, fig. 20) broad with S-shaped inner margin, distinctive for genus. Numerous radial pore canals are mostly confined to central portion of inner lamella, where they tend to converge on median salient of inner margin, Muscle scars obscure.

Length (right valve) 0.78 mm., height 0.39 mm. Length (left valve) 0.79 mm., height 0.42 mm.

Remarks.—*C. alexanderi* Howe and Chambers (1935, p. 45, pl. 5, figs. 17–21), a common form in the Jackson, is much larger, with numerous more prominent ridges. Most of my specimens from the type locality at Montgomery, Louisiana, show no pits, but minor pitting is present on some Jackson specimens. The Jackson species exhibits no crenulation of the bar and groove of the hinge line. The Weches species may easily be confused with *Cythereis evergreenica* (Stadnichenko), with which it occurs. This species of *Cythereis* is usually covered with horizontal ridges. The posterocardinal angle of the left valve is not produced and strongly prominent, and it lacks the broad, S-shaped anterior inner margin peculiar to *Cytheretta*.

The genus *Pseudocytheretta* Cushman (1906, p. 382) was placed in synonomy under *Cytheretta* by Müller (1912, p. 366). It appears impossible to distinguish Cushman's genus from the description, as the anterior inner margin characteristic of *Cytheretta* is present but less prominent.

Types.—Syntypes, no. 3363 (right valve), no. 3364 (left valve), from sample 2.

Genus XESTOLEBERIS Sars, 1865

Xestoleberis Sars, G. O., 1865, Oversigt af Norges marine Ostracoder: Vidensk selsk. Oslo Forh., p. 66. Müller, G. W., 1894, Fauna und Flora des Golfes von Neapel, Mon. 21, Ostracoden, p. 332.

Genotype: *Cythere aurantia* Baird, W., 1838, in Mag. Zoology, Botany, vol. 2, p. 143, pl. 5, fig. 26.

XESTOLEBERIS DUMBLEI
Stephenson, n. sp.
Plate 43, figure 16

Carapace small, in side view elongate, subovate. Left valve larger than right, with greatest overlap along dorsal and ventral margins. Valves entirely smooth, moderately and evenly inflated. Greatest height and thickness somewhat posterior to middle. Anterior end of male rather narrowly rounded, with curvature continuous with gently arched dorsal margin. Ventral margin slightly sinuate in right valve, moderately convex on posterior half of left valve. Posterior end higher than anterior, bluntly truncated, steeply sloping to rounded postero-ventral angle. Female carapace higher, more broadly rounded. Hinge structure delicate, in right valve with an elongate, finely serrate anterior dental area, and a shorter, similar posterior dentition, with a slender groove between them. In left valve, hinge bears corresponding notched terminal sockets joined by a narrow bar.

Length (complete specimen) 0.37 mm., height 0.21 mm., width 0.19 mm.

Remarks.—Most specimens of this species are very small, although an occasional carapace attains moderate size for the genus. A similar form from the Jackson Eocene is seen in *X. sarsi* Howe and Chambers (1935, p. 48, pl. 3, fig. 9). A study of topotypes of the Jackson species from Water Valley, Alabama, indicates that the figure and descrip-

tion have been based on the female. The Weches form is smaller, less inflated, and lower in proportion to its length in both male and female.

Types.—Holotype, no. 3365 (complete specimen), from sample 12.

Genus HAPLOCYTHERIDEA Stephenson, 1936

Cytheridea Bosquet (part), of authors. (Bosquet, J., 1852, Description des entomostracés fossiles des terrains Tertiaires de la France et de la Belgique: Acad. royale sci. Belgique, Mem., vol. 24, p. 37.)
Cytheridea (*Haplocytheridea*) Stephenson, M. B., 1936, Jour. Paleontology, vol. 10, p. 700.
Cytheridea (*Leptocytheridea*) (part) Stephenson, M. B., 1937, idem, vol. 11, p. 156.
Cytheridea (*Phractocytheridea*) Sutton, A. H., and Williams, J. R., 1939, idem, vol. 13, p. 571.
Haplocytheridea Stephenson, M. B., 1944, idem, vol. 18, p. 159.
Genotype: *Cytheridea montgomeryensis* Howe, H. V., and Chambers, J., 1935, Louisiana Dept. Cons. Geol. Bull. 5, p. 17, pl. 1, fig. 1; pl. 2, figs. 1–3, 7, 9; pl. 6, figs. 17, 18.

In side view carapace tumid, elongate, subpyriform to subovate, highest at or somewhat anterior to middle. Left valve normally larger than right. Dorsal margin somewhat convex, usually flattened along hinge line, and sloping to posterior. Ventral margin straight to moderately convex, in some species sinuate. Anterior end high, broadly rounded, in some forms armed with short spines. Posterior end typically lower and narrower, truncated to the rounded or subacute posteroventral angle. Valves smooth, pitted, or rather weakly ornamented, rarely highly sculptured. Hinge structure (see Stephenson, 1936, pl. 94, figs. 3, 4; text fig. 1 *g*) in right valve consists of terminal elongate, taxodont dental areas at the cardinal angles, each notched to form several cusps. A lower line of fine crenulations forms a bar between the dentitions, and is normally separated from the dorsal margin by a shallow depressed area. Hinge in the left valve possesses notched sockets which articulate with the dentitions of the right valve. Between the sockets and continuous with them is a finely crenulate groove just below the dorsal margin. Line of concrescence coincides with inner margin except on anterior and posterior, where it extends into marginal area subparallel to periphery in many species. Radial pore canals usually straight, simple, not bifurcated, most species showing 30 to 35 and occasional forms only 15 to 20 pore canals on anterior, with a fewer number on posterior. Muscle scar pattern (see Stephenson, 1936, text fig. 1 *h*) consists of a vertical row of four small ovoid scars, with two more elongate scars situated anterior to the row, one placed above the other.

Haplocytheridea was originally described by me (Stephenson, 1936, p. 700) as a subgenus under *Cytheridea* Bosquet. Subsequent study has shown the shell characters to be constant within narrow limits, and these characters appear distinctive enough to warrant elevating *Haplocytheridea* to generic rank. The genus is present, and often rather common, in faunas throughout most of the American Cretaceous and Tertiary section, and has been reported by Triebel (1938a) from the Cretaceous of Germany. I have seen the typical *Cytheridea* (restricted) only in material from Europe.

The diagnostic feature for separation of the genus *Haplocytheridea* from *Cytheridea* (restricted) and *Clithrocytheridea* is the structure of the hinge line. This feature is simpler in *Haplocytheridea* than in the typical *Cytheridea*. The genus *Clithrocytheridea* exhibits a crenulate groove between the terminal dentitions of the right valve, a characteristic which distinguishes it from *Haplocytheridea*, which has an elevated row of crenulations forming the hinge line between the dental areas. The subgenus *Cytheridea* (*Phractocytheridea*) Sutton and Williams (1939, p. 571) was proposed for the slight variant shown in the hingement of *C.* (*P.*) *compressa* Sutton and Williams (1939, p. 572, pl. 64, figs. 23–25), a Weches species included in this report as *Haplocytheridea veatchi* (Howe and Garrett). *Cytheridea* (*Phractocytheridea*) was discussed by me (Stephenson, 1941, pp. 427, 428) and shown to have such close affinities that it should be classed under *Haplocytheridea*.

Occasional specimens from the Weches indicate that various molt stages occur in species of *Haplocytheridea*. The shell characters of these molt valves were outlined by me (1937, p. 156) as typical for *Leptocytheridea*, a subgenus later shown to be invalid (Stephenson, 1941, p. 425).

Several species of *Haplocytheridea* have

been reported to exhibit reversal of valve size and elements of the hinge line. In a generic description of *Cytheridea*, Brady (1880, p. 112) noted the hinge to be " . . . composed of two crenulated crests on the left (occasionally the right) valve . . . " It was not stated whether *Cytheridea spinulosa* Brady, the only species of *Cytheridea* in the *Challenger* Report, was a form showing this feature. The anomaly was later reported as present on *Haplocytheridea insolita* (Alexander and Alexander) (1933) from the Cretaceous of Texas. *H. bradyi* Stephenson (1938, p. 129) from the Pliocene of Florida, and *H. proboscidiala* Edwards (1944, p. 508) from the Miocene of North Carolina are later records of reversals of these shell characters.

The range of *Haplocytheridea* is Cretaceous to Recent.

Haplocytheridea montgomeryensis (Howe and Chambers) Stephenson
Plate 42, figure 29

Cytheridea montgomeryensis Howe and Chambers, 1935, Louisiana Dept. Cons. Geol. Bull. 5, p. 17, pl. 1, fig. 1; pl. 2, figs. 1–3, 7, 9; pl. 6, figs. 17, 18.

Cytheridea (*Haplocytheridea*) *montgomeryensis* Howe and Chambers. Stephenson, 1936, Jour. Paleontology, vol. 10, p. 700, pl. 94, figs. 3, 4, 9; text figs. 1*g*, *h*, *j*, *k*.—Stephenson, 1937, idem, vol. 11, p. 153.—Stephenson, 1942, idem, vol. 16, p. 109, pl. 18, figs. 17, 18.

Cytheridea montgomeryensis Howe and Chambers. Bergquist, 1942, Mississippi Geol. Survey Bull. 49, p. 106, pl. 11, fig. 5.

Carapace in side view elongate, subpyriform. Left valve larger than right, overlapping around entire periphery. Dorsal margin gently arched, flattened along hinge line. Ventral margin weakly convex, more strongly so in left valve. Anterior end broadly rounded, often armed with short spines on ventral half. Posterior end lower, tapering to posteroventral angle, which is subacute on right valve and narrowly rounded on the left, weakly spinose on some specimens. Tumid portion of carapace ornamented by series of vertical, curvilinear furrows, those in front of center convex toward anterior, those behind center curved toward posterior. Each furrow bears a number of rather small pits. Carapace is smooth except for central portion. Hingement and muscle scar area as defined for genus.

Length (male) 0.90 mm., height 0.47 mm., width 0.39 mm. Length (right valve) 0.91 mm., height 0.43 mm. Length (left valve) 0.81 mm., height 0.44 mm.

Occurrence.—The presence of the genotype in the Weches constitutes the lowermost occurrence known to me. It is rare at Smithville, and most Weches specimens showing a similar furrowed ornamentation are referred to *H. stuckeyi*, n. sp. *H. montgomeryensis* occurs in the Cane River formation, at the type locality near Natchitoches, Louisiana. The species likewise is present in my Claiborne collections from the Cook Mountain formation of Texas and Louisiana, and the Lisbon and Gosport formations at Claiborne Bluff on Alabama River, Alabama. Originally described from the lower Jackson at Montgomery, Louisiana, it occurs and is usually common at most localities in the lower and middle Jackson of Louisiana and Mississippi.

Types.—Hypotypes, no. 3366 (complete specimen), from sample 7; no. 3367 (right valve), no 3368 (left valve), from sample 6.

Haplocytheridea ellisi Stephenson, n. sp.
Plate 42, figure 21

Carapace tumid, in side view elongate, subpyriform. Dorsal margin well arched, flattened along hinge line, sloping gently to posterior. Ventral margin straight to slightly concave in smaller right valve, convex on its anterior two-thirds in the larger left valve. Anterior end broadly rounded, bluntly spinose on ventral portion on some specimens. Posterior end narrower, compressed, in right valve gently sloping to subacute posteroventral angle, in left valve more steeply truncated from higher posterocardinal angle to narrowly rounded posteroventral angle, which may be weakly spinose. Surface strongly ornamented, with sculpturing nearly as pronounced on left valve as on right. A prominent, subcentral, smooth, hemispherical node slightly anterior and ventral to center of carapace is surrounded by a depressed area with irregular surface. Depression extends dorsally around smaller, less pronounced node below anterocardinal angle. Shell wall anterior to depression is inflated and papillose. A strong inflation

showing irregular carving occupies posterodorsal portion of shell, with faint papillae along crest of its posterior projection. This inflation rises abruptly from the broad, horizontal channel through center of shell posterior to central depression. Channel is flanked ventrally by a strong, rounded, curvilinear ridge, extending well above and subparallel to ventral margin. Posterior half of carapace shows some pronounced pits over sculptured areas, with shell wall entirely smooth in area adjacent to posteroventral angle. Hinge structure of right valve between notched terminal dentitions is a faintly crenulate bar somewhat depressed toward its center, with a narrow, well incised trench between it and dorsal margin. In the left valve between notched sockets is a shallow crenulate groove inside the somewhat overhanging, infolded dorsal margin.

Length (right valve) 0.71 mm., height 0.40 mm. Length (left valve) 0.70 mm., height 0.44 mm.

Remarks.—*H. ellisi* is the most highly ornate species of the genus which I have encountered in Tertiary sediments of the Gulf Coastal Plain. It is superficially similar to *H. sabinensis* (Howe and Garrett 1934, p. 40) from the Wilcox Eocene, but is more strongly sculptured, it possesses a distinctive subcentral node which is absent on *H. sabinensis*, and exhibits almost as much ornamentation on the left valve as on the right. The Wilcox form normally shows weak sculpturing on the left valve.

H. ellisi occurs only in the Weches in the author's collections. It is distinctive enough to be a guide fossil, but unfortunately is rare at the outcrop and sporadic in subsurface strata of Weches age.

Named for A. D. Ellis, Jr., paleontologist, Stanolind Oil and Gas Company, Houston, Texas.

Types.—Syntypes, no. 3369 (right valve), from sample 3; no. 3370 (left valve), from sample 11.

HAPLOCYTHERIDEA MOODYI
(Howe and Garrett) Stephenson
Plate 42, figure 25; plate 44, figure 15

Cytheridea moodyi Howe and Garrett, 1934, Louisiana Dept. Cons. Geol. Bull. 4, p. 35, pl. 2, figs. 2–6.

Cytheridea (*Haplocytheridea*) *moodyi* Howe and Garrett. Stephenson, 1938, Jour. Paleontology, vol. 12, p. 573, pl. 67, fig. 3; text figs. 3, 4.

Cytheridea (*Haplocytheridea*) *subovata* Sutton and Williams (*not* (Münster), 1830), 1939, idem, vol. 13, p. 569, pl. 64, figs. 26–28.

Cytheridea (*Haplocytheridea*) *bastropensis* Sutton and Williams, 1940, idem, vol. 14, p. 163.

Carapace tumid, in side view subovate to subpyriform. Left valve larger than right, overlapping around entire periphery. Dorsal margin moderately arched, sloping to posterior. Ventral margin convex in left valve, somewhat sinuate in right. Anterior end broadly rounded, sometimes faintly denticulate; posterior end lower, more narrowly rounded to the blunt posteroventral angle, which occasionally shows one or two obscure spines. Tumid portion of carapace shows a series of vertical curvilinear furrows, those in front of middle arcuate toward anterior, those behind middle curved toward posterior. A series of pits occupies each furrow. Ornamentation reduced toward edge of shell, leaving peripheral area smooth except for scattered obscure pits marking positions of normal pore canals.

Length 0.86 mm., height 0.47 mm., width 0.39 mm. Length (right valve) 0.84 mm., height 0.44 mm. Length (left valve) 0.87 mm., height 0.47 mm.

Remarks.—The curvilinear furrows on average specimens of this species in the Weches are reduced in number and extent, as compared with normally ornamented carapaces from the Wilcox Eocene. Careful study of a large suite of specimens shows, however, that it is impossible to separate the more highly ornamented of the Weches representatives from some of the Wilcox specimens which are less than typically sculptured.

Occurrence.—Described from the Wilcox, the species is absent from my Reklaw material. It is common in the Weches, but usually not present in the Cane River, although I have several specimens from that formation in a sample which contains the foraminifer *Discocyclina advena* (Cushman) from Natchitoches Parish, Louisiana.

Types.—Hypotypes, no. 3371 (complete specimen), no. 3372 (right valve), no. 3373 (left valve). All specimens are from sample 3.

HAPLOCYTHERIDEA NOWOTNYI
Stephenson, n. sp.
Plate 42, figure 26

Carapace tumid, in side view subovate. Left valve larger than right, overlapping except at posteroventral angle. Dorsal margin moderately arched between weak cardinal angles. Ventral margin less convex than dorsal, often somewhat sinuate, rising toward posterior. Anterior end well rounded, usually weakly spinose on ventral half. Posterior end lower, sloping in even curve to narrowly rounded posteroventral angle, which usually bears one or two blunt spines. Valves well and evenly inflated. Surface smooth except for fairly numerous small, shallow, inconspicuous pits marking positions of normal pore canals.

Length (complete specimen) 0.80 mm., height 0.44 mm., width 0.37 mm. Length (right valve) 0.79 mm., height 0.41 mm. Length (left valve) 0.83 mm., height 0.46 mm.

Remarks.—This species is very similar to *H. mossomi* Stephenson (1945, p. 381, text figs. 1, 2) from the Cook Mountain. It is somewhat more strongly inflated and more nearly ovate in side view, with the cardinal angles higher, the dorsal margin more steeply sloping toward the posterior, and the ventral margin more convex. A closely allied form in the Weches is *H. moodyi*, from which *H. nowotnyi* may be separated by absence of the curvilinear furrows. This species I have observed only in the Weches.

Named for Wilbur A. Nowotny, geologist, Stanolind Oil and Gas Company, San Antonio, Texas.

Types.—Holotype, no. 3374 (complete specimen), from sample 6. Paratypes, no. 3375 (right valve), no. 3376 (left valve), from sample 5.

HAPLOCYTHERIDEA STUCKEYI
Stephenson, n. sp.
Plate 42, figure 31; plate 44, figures 7, 8

Carapace of male elongate, subpyriform. Left valve larger than right, overlapping around entire periphery, with greater overlap around dorsal margin and very strong overlap near center of ventral margin. Dorsal margin of right valve moderately arched, more strongly so in left valve. Ventral margin of right valve somewhat convex on anterior, faintly indented toward posterior. Ventral margin of left valve rather strongly convex on anterior, more weakly so toward posterior. Anterior end high, broadly and evenly rounded, often spinose on ventral half. Posterior end low, tapering to narrowly rounded posteroventral angle, which sometimes bears one or two blunt spines. Short, rudimentary spines are occasionally developed on posterior portion of ventral margin. Valves well and evenly inflated, somewhat compressed toward posterior. Tumid portion of surface ornamented with about 4 to 6 vertical, curvilinear furrows, those in front of middle arcuate toward anterior, those behind middle gently curved toward posterior. Each furrow bears a series of small pits, and a low, rounded ridge separates the furrows. Only central portion of carapace is ornamented, leaving peripheral area smooth except for occasional obscure pits marking positions of normal pore canals. Ornamentation is reduced on some specimens to a few pits on tumid portion. Female carapace shorter, much higher, more inflated than male, more bluntly truncated on posterior, and with stronger ventral overlap.

Length (male) 0.89 mm., height 0.52 mm., width 0.40 mm. Length (female) 0.81 mm., height 0.53 mm., width 0.40 mm. Length (right valve) 0.84 mm., height 0.45 mm. Length (left valve) 0.79 mm., height 0.51 mm.

Remarks.—*H. stuckeyi* is rather common in the Weches. It is allied to the Jackson Eocene species *H. montgomeryensis*, which occurs rarely in the Weches. *H. stuckeyi* may be distinguished from the genotype through its heavier shell, its greater height in proportion to length, its somewhat greater dorsal overlap, and its very strong ventral overlap. The new species is confined to the Weches in my collections.

Named for Charles W. Stuckey, Jr., paleontologist, Stanolind Oil and Gas Company, Houston, Texas.

Types.—Syntypes, no. 3377 (complete specimen, male), no. 3378 (complete specimen, female), no. 3379 (right valve), no. 3380 (left valve). All specimens are from sample 3.

HAPLOCYTHERIDEA VEATCHI (Howe and Garrett) Stephenson

Plate 42, figure 27; plate 44, figure 14

Cytheridea mülleri (Münster) (part). Cushman, 1925, Am. Assoc. Petroleum Geologists Bull. vol. 9, p. 301, pl. 8, figs. 4a–c (*not* pl. 8, fig. 5).
Cytheridea veatchi Howe and Garrett, 1934, Louisiana Dept. Cons. Geol. Bull. 4, p. 43, pl. 3, figs. 1–4.
Cytheridea (*Haplocytheridea*) *veatchi* Howe and Garrett. Stephenson, 1938, Jour. Paleontology, vol. 12, p. 574, pl. 67, fig. 6; text figs. 25–27.
Cytheridea (*Phractocytheridea*) *compressa* Sutton and Williams, 1939, idem, vol. 13, p. 572, pl. 64, figs. 23–25.
Cytheridea (*Haplocytheridea*) *lisbonensis* Stephenson, 1942, idem, vol. 16, p. 108, pl. 18, figs. 11, 12.
Haplocytheridea lisbonensis Stephenson, 1944, idem, vol. 18, p. 449, pl. 76, fig. 12.

Carapace in side view low, elongate, subpyriform. Dorsal margin weakly arched, flattened along hinge line, sloping gently toward posterior. Ventral margin somewhat convex, rising toward posterior. Anterior end broadly and evenly rounded, usually weakly spinose. Posterior end low, more narrowly rounded to obscure posteroventral angle, which normally bears one short, blunt spine. Entire tumid portion of carapace closely covered with vertical curvilinear furrows, those in front of middle arcuate toward anterior, those behind midpoint curved toward posterior. Each furrow carries a number of small, shallow pits. Furrows extend from near dorsal margin to near ventral margin; area immediately adjacent to periphery smooth. Furrows separated by low, rounded ridges, which are broken in vicinity of posterior end to form papillae.

Length 0.78 mm., height 0.42 mm., width 0.34 mm. Length (right valve) 0.75 mm., height 0.38 mm. Length (left valve) 0.77 mm., height 0.43 mm.

Remarks.—Topotype specimens of this species from the Wilcox Eocene at Sabinetown, Texas have a somewhat more rhomboidal outline, and usually a more heavily impressed ornamentation than those from the Weches. The shell structure is very similar, however, and some specimens are so nearly identical that separation seems impossible. Specimens described by me (Stephenson, 1942, p. 108, pl. 18, figs. 11, 12) as *Cytheridea* (*Haplocytheridea*) *lisbonensis* from the Lisbon formation (Claiborne Eocene) of Alabama are here referred to *H. veatchi*. Lisbon specimens are identical with those from the Weches except for their smaller size.

Occurrence.—In the Wilcox, I have *H. veatchi* from the Nanafalia, Bashi, and Hatchetigbee formations of Alabama, and at Marthaville, Louisiana, and Sabinetown, Texas. In the Claiborne, it is present in the Reklaw, Weches and Cook Mountain formations of Texas, it is rare in the Cane River of Louisiana, and common in the Lisbon of Alabama. It is rare in the Claiborne on Moctezuma River, Mexico.

Types.—Hypotypes, no. 3381 (complete (specimen), no. 3382 (right valve), no. 3383 (left valve). All specimens are from sample 3.

HAPLOCYTHERIDEA WALLACEI (Howe and Garrett) Stephenson

Plate 42, figure 28

Cytheridea mülleri (Münster) (part). Stadnichenko, 1927, Jour. Paleontology, vol. 1, p. 238, pl. 39, figs. 14–17 (*not* fig. 13).
Cytheridea wallacei Howe and Garrett, 1934, Louisiana Dept. Cons. Geol. Bull. 4, p. 44, pl. 3, fig. 5–8.
Cytheridea (*Haplocytheridea*) *wallacei* Howe and Garrett. Stephenson, 1938, Jour. Paleontology, vol. 12, p. 575, pl. 67, fig. 25; text figs. 17, 18.
Cytheridea (*Haplocytheridea*) *habropapillosa* Sutton and Williams, 1939, idem, vol. 13, p. 570, pl. 64, figs. 20–22. Stephenson, 1942, idem, vol. 16, p. 107, pl. 18, figs. 21, 22.
Haplocytheridea habropapillosa Sutton and Williams. Stephenson, 1944, idem, vol. 18, p. 449, pl. 76, fig. 4.

Carapace tumid, in side view subpyriform. Dorsal margin well arched, flattened along hinge line, sloping toward posterior. Ventral margin convex on anterior, indented toward posterior, usually partially hidden in central portion by overhanging carapace wall. Anterior end broadly and obliquely rounded, in most specimens bearing a series of short, blunt, peripheral spines on ventral half. Posterior end somewhat compressed, rather steeply sloping to postero-ventral angle, which is subacute in smaller right valve, and narrowly rounded in left valve, many individuals bearing one or two blunt spines, and several short, rudimentary spines on adjacent portion of ventral margin. Tumid portion of carapace to near pe-

riphery is rather closely covered with hemispherical papillae of moderate size. Papillae have no pattern in central area, but tend to be aligned subparallel to periphery on outer portion of ornamented area, often coalescing into noded ridges on postero-dorsal region and on ventral slope. Carapace nude and smooth near periphery.

Length (complete specimen) 0.77 mm., height 0.42 mm., width 0.41 mm. Length (right valve) 0.77 mm., height 0.39 mm. Length (left valve) 0.76 mm., height 0.40 mm.

Remarks.—Topotypes of the species from the Wilcox Eocene at Sabinetown, Texas, are larger, usually are lower at the antero-cardinal angle, with a weakly convex to slightly sinuous ventral margin which tends to be less indented toward posterior, and the surface is normally ornamented over a wider area. Study of a large suite of specimens has shown, however, that some individuals from the Weches are indistinguishable from Wilcox specimens.

Occurrence.—*H. wallacei* was originally reported (Howe and Garrett, 1934, p. 45) from the Wilcox of Texas, Louisiana, and Alabama. Additional occurrences in my collection indicate it to be rare in the Reklaw, and common in the Weches and Cook Mountain formations of Texas. It is likewise present in the Cane River of Louisiana, and the Lisbon of Alabama. I have not found this papillose species in material younger than Claiborne Eocene in sediments of the Gulf Coastal Plain.

Types.—Hypotypes, no. 3384 (complete specimen), no. 3385 (right valve), no. 3386 (left valve). All specimens are from sample 7.

Genus CLITHROCYTHERIDEA Stephenson, 1936

Cytheridea Bosquet (part), of authors. (Bosquet, J., 1852, Description des entomostracés fossiles des terrains Tertiaires de la France et de la Belgique: Acad. royale sci. Belgique, Mem., vol. 24, p. 37.)

Cytheridea? Howe, H. V., and Garrett, J. B., 1934, Louisiana Dept. Cons. Geol. Bull. 4, pp. 30, 32, 37.

Cytheridea (*Clithrocytheridea*) Stephenson, M. B., 1936, Jour. Paleontology, vol. 10, p. 702.

Cytheridea (*Leptocytheridea*) (part) Stephenson, M. B., 1937, idem, vol. 11, p. 156.

Clithrocytheridea Stephenson, M. B., 1944, idem, vol. 18, p. 449.

Genotype: *Cytheridea? garretti* Howe and Chambers, 1935, Louisiana Dept. Cons. Geol. Bull. 5, p. 14, pl. 1, figs. 4, 5; pl. 2, figs. 11, 12; pl. 6, figs. 10, 11.

Viewed from the side, the carapace of members of this genus is elongate, subpyriform to subquadrate. Dorsal margin arched and sloping toward posterior; ventral margin straight to somewhat convex. Anterior end is high, well rounded, at times bluntly denticulate on ventral half. Posterior end lower, sloping to narrowly rounded or subacute postero-ventral angle. Surface of valves smooth, pitted, or variously ornamented, some species showing heavy sculpturing. Hinge structure diagnostic in determination of genus. In the right valve, raised, terminal, taxodont dental areas are notched to form several cusps. These dentitions are truncated into a crenulate groove forming the hinge line between them. In the left valve, elongate, notched, well incised sockets articulate with the dentitions of the right valve, and these sockets are joined by an elevated, crenulated bar. In many species the marginal area of the right valve is equipped with an acute carina, just inside and parallel to outer edge of valve, which fits into a groove or lip line in the left valve. The other finer characters of shell structure are identical with those ascribed to the genus *Haplocytheridea*.

Remarks.—Numerous species of this genus exhibit pronounced surface sculpturing, but this feature is unreliable for determinations in systematic work. At best, it provides only a better guess in working with undescribed material where no separate valves are available for study. The hinge structure is the diagnostic criterion for proper placement of species under this genus. My observations indicate *Clithrocytheridea* usually is a smaller element than *Haplocytheridea* in the Tertiary microfaunas of the Gulf Coastal Plain.

The known range of *Clithrocytheridea* is Eocene to Miocene. It appears from the description and figures that *Cytheridea? pedroensis* LeRoy (1943, p. 359, pl. 58, figs. 15–20), from the San Pedro formation (Pleistocene?) of California, probably should be referred to this genus, although I have not studied specimens of this form.

CLITHROCYTHERIDEA GARRETTI
(Howe and Chambers) Stephenson
Plate 42, figure 18

Cytheridea? garretti Howe and Chambers, 1935, Louisiana Dept. Cons. Geol. Bull. 5, p. 14, pl. 1, figs. 4, 5; pl. 2, figs. 11, 12; pl. 6, figs. 10, 11.
Cytheridea (Clithrocytheridea) garretti Howe and Chambers. Stephenson, 1936, Jour. Paleontology, vol. 10, p. 702, pl. 94, figs. 5, 6, 10; test figs, 1, *l*, *o*, *p*. Stephenson, 1942, idem, vol. 16, p. 110, pl. 18, fig. 1.
Clithrocytheridea garretti (Howe and Chambers). Stephenson, 1944, idem, vol. 18, p. 449, pl. 76, fig. 1.

Carapace of moderate size, in side view elongate, subpyriform. Dorsal margin moderately arched, in some specimens indented along hinge line, sloping toward posterior. Ventral margin straight to slightly concave. Anterior end broadly and obliquely rounded; posterior end lower, tapered to narrowly rounded posteroventral angle. Surface covered with numerous ovoid pits of moderate size and depth. Finer characters of shell structure as defined for genus.

Length (right valve) 0.58 mm., height 0.32 mm. Length (left valve) 0.68 mm., height 0.33 mm.

Remarks.—Weches specimens of the genotype are considerably smaller than those from the Jackson Eocene. The holotype (Howe and Chambers, 1935, p. 14) has the following dimensions: length 0.83 mm., height 0.40 mm., width 0.38 mm. In addition to their larger size, specimens from the type locality in the Cocoa sand on Keyser Hill near Water Valley, Alabama, are somewhat more strongly pitted. The specimens at hand are so similar that any attempt at separation is impractical.

Occurrence.—*C. garretti* is present in the Claiborne of Texas in the Reklaw and Weches formations of Bastrop County, and the Cook Mountain of Lee County. It occurs in the Cook Mountain at Columbus, Louisiana, and in the Lisbon and Gosport of Alabama. Jackson occurrences of the genotype include the type locality in the Cocoa sand (of C. W. Cooke) of Alabama; in Mississippi, in the Moodys Branch marl on Town Creek near Jackson, and the Cocoa sand at Shubuta. Though somewhat sporadic and often rare in its occurrence, the range of *C. garretti* appears to be throughout Claiborne and Jackson times in various parts of the Eocene sediments of the Gulf Coastal Plain.

Types.—Hypotypes, no. 3387 (right valve), from sample 4; no. 3388 (left valve), from sample 3.

CLITHROCYTHERIDEA CALDWELLENSIS
(Howe and Chambers) Stephenson
Plate 42, figure 13

Cytheridea? caldwellensis Howe and Chambers, 1935, Louisiana Dept. Cons. Geol. Bull. 5, p. 11, pl. 1, fig. 7; pl. 2, figs. 4–6.
Cytheridea (Clithrocytheridea) caldwellensis Howe and Chambers. Stephenson, 1937, Jour. Paleontology, vol. 11, p. 154, pl. 26, fig. 13.

Carapace in side view subrhomboidal. Dorsal margin indented between rounded cardinal angles, sloping toward posterior. Ventral margin nearly straight, somewhat sinuated. Anterior end high, broadly and obliquely rounded. Posterior end lower, steeply sloping to narrowly rounded posteroventral angle. Surface covered with numerous pits of variable size and shape, superimposed over other sculpturing. A thickened rounded rim extends somewhat inside and subparallel to anterior margin. A low swelling occurs somewhat anterior and ventral to center of carapace. A prominent irregularly carved node is situated somewhat in front of posterior cardinal angle just above midpoint of shell height, with a depressed area between it and the anterior swelling. Lower portion of carapace carries a rounded ridge subparallel to ventral margin.

Length (left valve) 0.52 mm., height 0.31 mm.

Remarks.—The Weches specimen figured is much smaller than typical forms from the Jackson Eocene, and the sculpturing is less strongly developed. The species is very rare in the Weches at Smithville. Additional occurrences from the Jackson are in the Moodys Branch marl at Montgomery, Louisiana and on Town Creek near Jackson, Mississippi.

Types.—Hypotype, no. 3389 (left valve), from sample 11.

CLITHROCYTHERIDEA SMITHVILLENSIS
Stephenson
Plate 42, figure 15

Cytheridea (Clithrocytheridea) smithvillensis Stephenson, 1942, Jour. Paleontology, vol. 16, p. 113, pl. 18, fig. 2.

Carapace tumid, in side view subreniform. Left valve larger than right, overlapping around entire periphery, only slightly at midpoint of hinge and at postero-ventral angle, most strongly at center of ventral margin. Dorsal margin moderately arched, sloping gently toward posterior. Ventral margin nearly straight in left valve, somewhat indented at center of right valve. Anterior end broadly and obliquely rounded; posterior end lower and narrower, but well rounded. Fairly numerous pits of shallow depth cover shell wall, marking positions of normal pore canals. Entire surface is etched by a very finely granular pitting.

Length (complete specimen) 0.66 mm., height 0.35 mm., width 0.31 mm.

Remarks.—This species is somewhat similar to *C. grigsbyi* (Howe and Chambers) (1935, p. 15, pl. 1, figs. 2, 3) from the Jackson Eocene. *C. grigsbyi* is much larger, showing a coarser pitting and an absence of the larger pits where normal pore canals are situated.

Occurrence.—In addition to the type locality at Smithville, the species is rather common in the Enterprise marl of the Claiborne of Mississippi, where specimens are larger than those from the Weches of Texas.

Types.—Hypotype, no. 3390 (complete specimen), from sample 11.

Clithrocytheridea subpyriformis (Sutton and Williams) Stephenson
Plate 42, figure 20

Cytheridea (*Haplocytheridea?*) *subpyriformis* Sutton and Williams, 1939, Jour. Paleontology, vol. 13, p. 571, pl. 64, figs. 1–4.

Carapace in side view elongate, subpyriform. Left valve larger than right, overlapping around entire periphery except at postero-ventral angle. Dorsal margin weakly arched, sloping gently toward posterior. Ventral margin nearly straight. Anterior end obliquely rounded; posterior end lower and more narrowly rounded. Numerous low, rounded ribs more or less parallel to periphery cover shell wall to near its margins. The shallow furrows thus formed contain slightly impressed pits, with slender riblets branching from the main ribs and tending to coalesce around them.

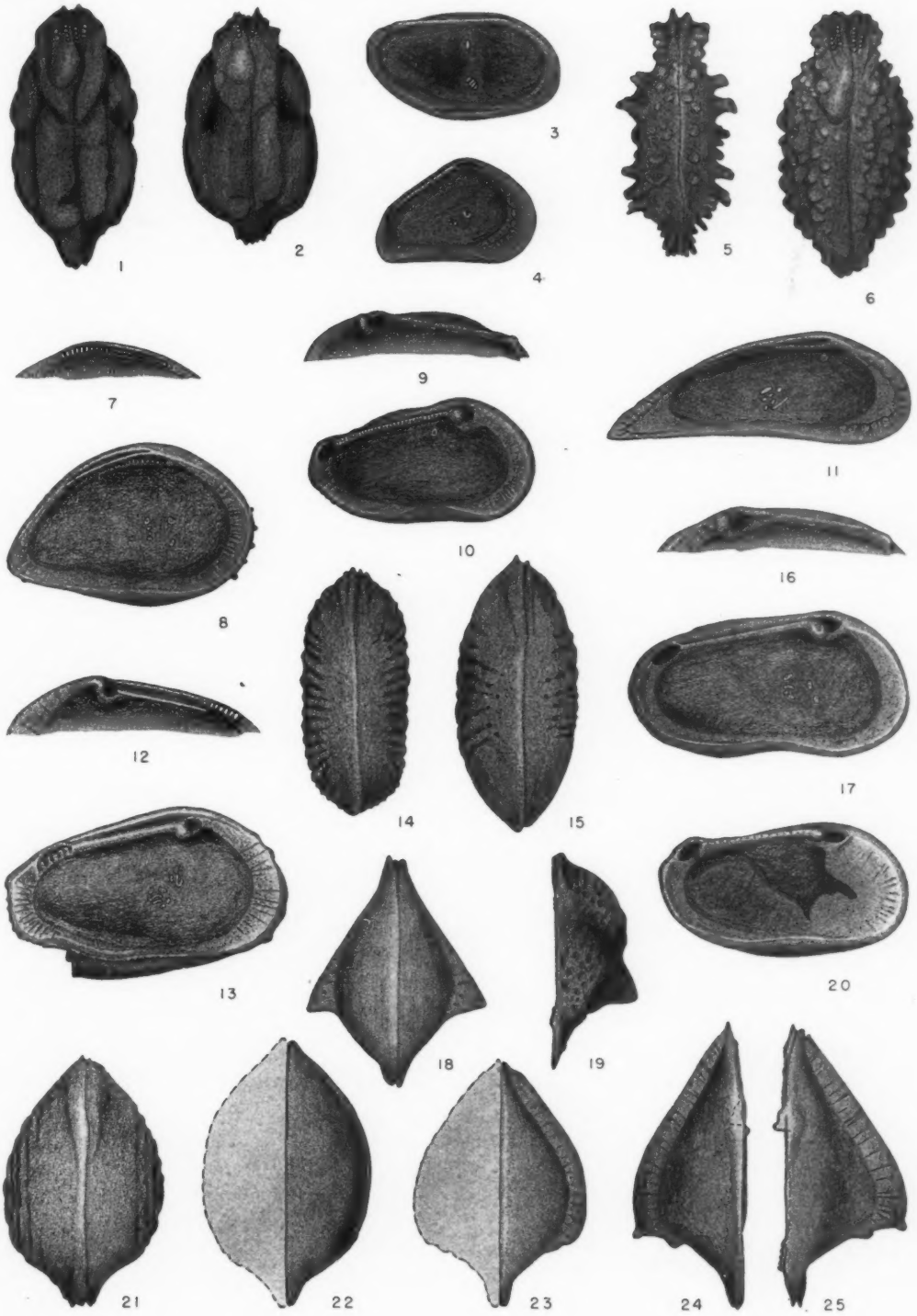
Length (complete specimen) 0.64 mm., height 0.34 mm., width 0.32 mm.

Remarks.—This rather small species has been identified by me only from the upper portion of the Viesca member, where it is not uncommon. It apparently replaces *C.*

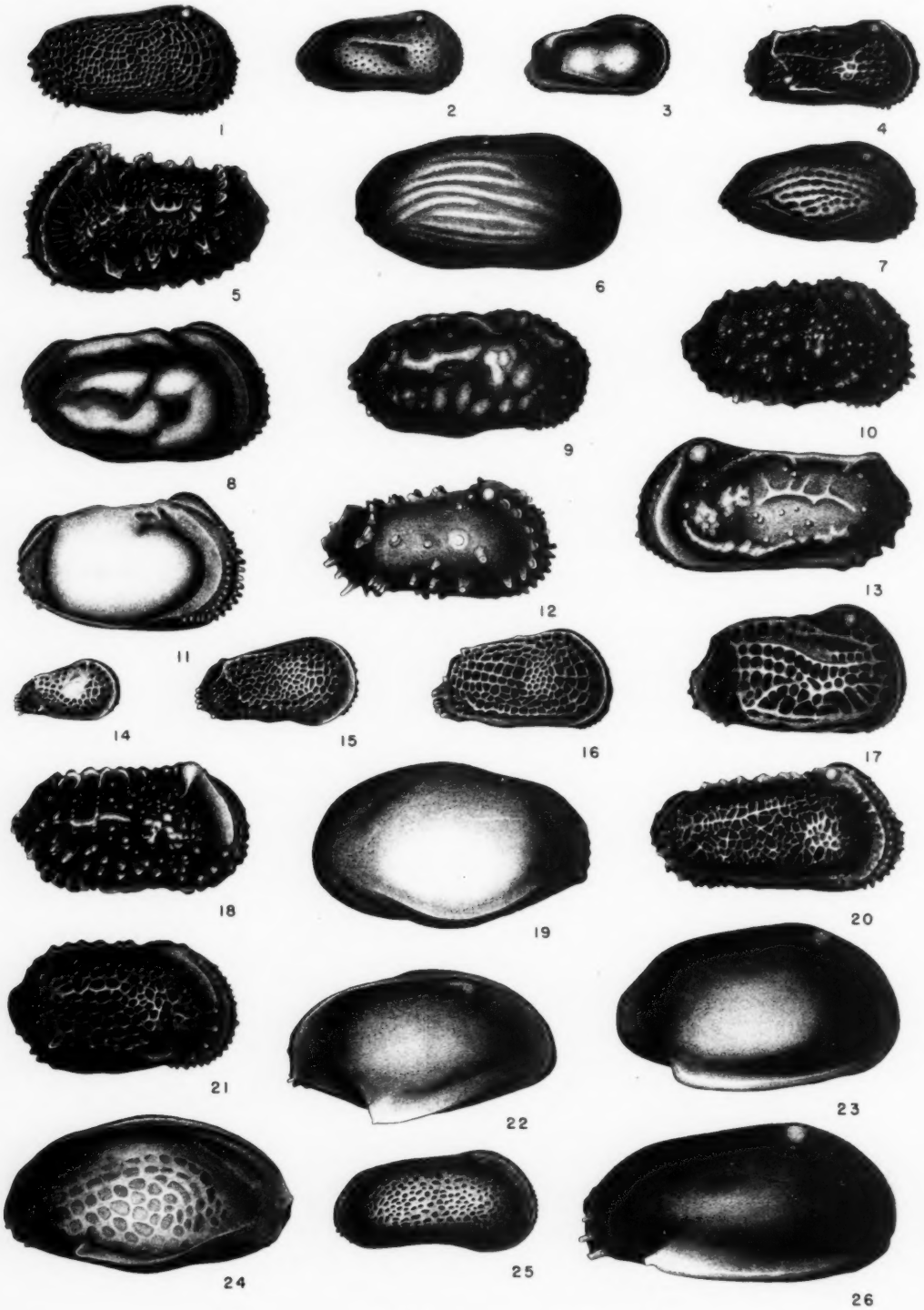
Explanation of Plate 44

Figures ×45, unless otherwise indicated

Figs. *1*—*Cythereis elmana* Stadnichenko. Dorsal view (p. 337)
2—*Cythereis viescana* Stephenson, n. sp. Dorsal view. (p. 342)
3—*Monoceratina laevis* Stephenson, n. sp. Interior of left valve. (p. 313)
4—*Eucythere pyramida* Stephenson, n. sp. Interior of left valve. (p. 314)
5—*Cythereis davidwhitei* Stadnichenko. Dorsal view. (p. 336)
6—*Cythereis splendens* Sutton and Williams. Dorsal view. (p. 340)
7, 8—*Haplocytheridea stuckeyi* Stephenson, n. sp. *7*, Hinge structure of right valve of female. *8*, Interior of left valve of female. (p. 324)
9, 10—*Pyricythereis subtriangularis* Sutton and Williams. *9*, Hinge structure of right valve. *10*, Interior of left valve. (p. 331)
11—*Paracypris franquesi* Howe and Chambers. Interior of left valve. ×40. (p. 309)
12, 13, 24, 25—*Brachycythere alata* (Bosquet). *12*, hinge structure of right valve. *13*, Interior of left valve. *24*, Dorsal view of left valve. *25*, Dorsal view of right valve, showing articulation of hinge. ×40. (p. 332)
14—*Haplocytheridea veatchi* (Howe and Garrett). Dorsal view. (p. 325)
15—*Haplocytheridea moodyi* (Howe and Garrett). Dorsal view. (p. 323)
16, 17—*Cythereis evergreenica* (Stadnichenko). *16*, Hinge structure of right valve. *17*, Interior of left valve. (p. 338)
18—*Brachycythere bernardi* Murray and Hussey. Dorsal view. ×40. (p. 332)
19—*Paracytheridea palmerae* Stephenson, n. sp. Dorsal view of right valve. (p. 319)
20—*Cytheretta tyusensis* Stephenson, n. sp. Interior of left valve. (p. 320)
21—*Brachycythere martini* Murray and Hussey. Dorsal view. ×40. (p. 333)
22—*Brachycythere russelli* Howe and Lea. Dorsal view of right valve. ×40. (p. 333)
23—*Brachycythere hadleyi* Stephenson, n. sp. Dorsal view of right valve. ×40. (p. 333)



Stephenson – Weches Eocene Ostracoda



Stephenson – Weches Eocene Ostracoda

wechesensis, which is confined to the Tyus and lower Viesca at Smithville. *C. wechesensis* shows more pronounced pitting and a complete absence of the pattern of ribs.

Types.—Hypotypes, no 3391 (complete specimen), no. 3392 (right valve), no. 3393 (left valve). All specimens are from sample 5.

CLITHROCYTHERIDEA WECHESENSIS
Stephenson
Plate 42, figure 19

Cytheridea (Clithrocytheridea) subpyriformis Sutton and Williams, var. *wechesensis* Stephenson, 1942, Jour. Paleontology, vol. 16, p. 113, pl. 18, fig. 14.

Carapace small, tumid, in side view subreniform. Left valve larger than right, overlapping around entire periphery with greatest overlap along ventral margin. Dorsal margin weakly arched; ventral margin slightly convex. Anterior end obliquely rounded; posterior end lower and sloping to more narrowly rounded postero-ventral angle. Shell wall closely covered with rather small, well impressed, ovoid pits.

Length (right valve) 0.56 mm., height 0.27 mm. Length (left valve) 0.57 mm., height 0.28 mm.

Remarks.—This species has been identified only in the Tyus and lower portion of the Viesca members of the Weches. It is replaced in the upper Viesca by *C. subpyriformis*, which is distinguished by the reticulate pattern of ribs and pitted furrows.

Types.—Hypotypes, no. 3394 (right valve), no. 3395 (left valve), from sample 9. (Figured specimen (pl. 42, fig. 19) is the holotype, no. 2282.)

Genus PYRICYTHEREIS Howe, 1936

Cythereis? Howe, H. V., and Pyeatt, L. M., 1934, in Howe, H. V., and Garrett, J. B., Louisiana Dept. Cons. Geol. Bull. 4, p. 50; 1935, in Howe, H. V., and Chambers, J., idem, Bull. 5, p. 33.
Buntonia Howe, H. V., 1935, in Howe, H. V., and Chambers, J., idem, Bull. 5, p. 22.
Pyricythereis Howe, H. V., 1936, in Howe, H. V., and Law, J., idem, Bull. 7, p. 65.
Genotype: *Cythereis? israelskyi* Howe and Pyeatt, 1935, in Howe and Chambers, idem, Bull. 5, p. 33, pl. 1, figs. 19–21; pl. 4, figs. 7–9.

Viewed from the side, carapace is elongate, subpyriform. Left valve larger than right and exhibiting a pronounced overlap at posterior cardinal angle. Dorsal and ventral margins somewhat convex and converging toward posterior. Anterior end high, broadly rounded; posterior end lower, truncated to bluntly angular postero-ventral angle. Surface smooth, pitted, or variously ornamented with ridges and furrows. Hinge line (pl. 44, figs. 9, 10) consists in right valve of a prominent knob-like anterior tooth with postjacent socket, followed by a crenulated groove extending to pos-

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EXPLANATION OF PLATE 45
All figures ×45

FIGS. *1*—*Cythereis russelli* Howe and Garrett. Right valve. (p. 339)
2—*Cythereis elongata* Sutton and Williams. Right valve view. (p. 337)
3—*Cythereis uptonensis* Stephenson. Right valve view. (p. 341)
4—*Cythereis claibornensis* Gooch. Right valve. (p. 336)
5—*Cythereis stenzeli* Stephenson, n. sp. Left valve. (p. 340)
6—*Cythereis evergreenica* (Stadnichenko). Right valve view. (p. 338)
7—*Cythereis sultoni* Stephenson, new name. Right valve view. (p. 340)
8—*Cythereis elmana* Stadnichenko. Right valve view. (p. 337)
9—*Cythereis wechesensis* Sutton and Williams. Right valve. (p. 342)
10—*Cythereis splendens* Sutton and Williams. Right valve. (p. 340)
11—*Cythereis viescana* Stephenson, n. sp. Right valve view. (p. 342)
12—*Cythereis davidwhitei* Stadnichenko. Right valve view. (p. 336)
13—*Cythereis bastropensis* Stephenson, n. sp. Left valve. (p. 334)
14–17—*Cythereis bursilloides* Stadnichenko. *14–16*, Right valves showing three different molt stages. *17*, Right valve view of adult. (p. 335)
18—*Cythereis linospinosa* Sutton and Williams. Right valve. (p. 338)
19—*Brachycythere russelli* Howe and Lea. Left valve. (p. 333)
20—*Cythereis orelliana* (Stadnichenko). Right valve view. (p. 338)
21—*Cythereis therrillensis* Stephenson, n. sp. Right valve. (p. 341)
22—*Brachycythere bernardi* Murray and Hussey. Right valve view. (p. 332)
23—*Brachycythere hadleyi* Stephenson, n. sp. Right valve. (p. 333)
24—*Brachycythere martini* Murray and Hussey. Right valve view. (p. 333)
25—*Cythereis claiborniana* (Stadnichenko). Right valve view. (p. 336)
26—*Brachycythere alata* (Bosquet). Right valve. (p. 332)

terior tooth. In left valve, hinge consists of an anterior socket, behind which is a tooth from which a narrow crenulated bar extends to posterior socket. Marginal areas are moderately broad and bear numerous radial pore canals. The muscle scar pattern of the genotype was indicated to consist of four ovoid scars in a vertical row with one crescentic scar anterior to them.

Remarks.—The crenulated character of the hinge line is insufficient as an absolute criterion for placing of species under this genus. *Cythereis* and several related genera exhibit a somewhat similar crenulated hinge line in their several molt stages. Additional helpful features in determinations are the pronounced overlap of the left valve over the right at the posterior cardinal angle, and the characteristic convergence of dorsal and ventral margins toward the posterior. Occasional molt carapaces of species of this genus were encountered in the Weches, such as the two valves of *P. subtriangularis* herein figured (pl. 42, figs. 22, 23). Such molt valves as these exhibit the finer shell characters defined for *Buntonia* Howe. These immature forms are here classed under the adult genus *Pyricythereis* Howe.

The genus was originally reported in Gulf Coast sediments from the Wilcox ("Sabine") to the Chickasawhay (Miocene?). My collections contain an undescribed species from the Recent of the Gulf of Mexico. The range of *Pyricythereis* is therefore Eocene to Recent.

PYRICYTHEREIS ALABAMENSIS
(Howe and Pyeatt)
Plate 42, figure 12

Cythereis? alabamensis Howe and Pyeatt, 1934, in Howe and Garrett, Louisiana Dept. Cons. Geol. Bull. 4, p. 50, pl. 4, figs. 2, 5, 7–10.
Pyricythereis alabamensis (Howe and Pyeatt) (part). Stephenson, 1944, Jour. Paleontology, vol. 18, p. 453.

Carapace in side view elongate, subpyriform. Left valve larger than right, overlapping around entire periphery except at postero-ventral angle, with strong overlap at postero-cardinal angle. Dorsal and ventral margins convex, sinuated, converging toward posterior, with ventral margin rising to postero-ventral angle. Anterior end high, broadly rounded, bearing a low, sharp, keel-like rim near and parallel to periphery. Posterior end low, somewhat compressed, bluntly angulated. Surface ornamentation consists of a series of low, irregular ribs diverging from near posterior end. Surface between ribs shows strong pits of varying size and shape, with riblets tending to coalesce around pits, forming a raised reticulate pattern.

Length (complete specimen, male) 0.66 mm., height 0.37 mm., width 0.31 mm. Length (complete specimen, female) 0.55 mm., height 0.34 mm., width 0.28 mm.

Remarks.—This species differs from *P. subtriangularis* in the heavy pitting covering the carapace wall. It has a different outline in side view, is much larger, and possesses ribs absent from *P. howei*, n. sp.

Types.—Hypotypes, no. 3396 (complete specimen, male), from sample 5; no. 3397 (complete specimen, female), from sample 6.

PYRICYTHEREIS HOWEI
Stephenson, n. sp.
Plate 42, figures 16, 17

Carapace small, in side view elongate, subrhomboidal. Left valve larger than right, overlapping strongly on ventral margin and at postero-cardinal angle; right valve overlaps left along central portion of hinge line. Male is long and low, with dorsal margin weakly arched in right valve, straight and sloping gently to posterior in left. Ventral margin rises in gentle curve from midpoint to anterior, curves strongly upward in posterior half. Anterior end obliquely rounded. Posterior end compressed, bluntly truncated to narrowly rounded postero-ventral angle somewhat below midpoint of shell height. Female similar but much higher in proportion to length. A broad, low, thickened rim extends around anterior end, with an elongate depression just behind it which is pronounced in vicinity of antero-dorsal angle. Surface covered with fairly closely spaced, well impressed, ovoid pits of moderate size. Pits on central portion of shell wall usually larger, those on outer portion often tending to be aligned in rows subparallel to periphery.

Length (complete specimen, male) 0.50 mm., height 0.27 mm., width 0.27 mm. Length (complete specimen, female) 0.56 mm., height 0.32 mm., width 0.32 mm.

Remarks.—This species is much smaller, and has a much more obliquely rounded an-

terior end than *P. alabamensis*. The several ribs across the central area of that species are lacking on *P. howei*. The new species has a moderately heavy shell, and is readily distinguishable from molts of *P. alabamensis* and *P. subtriangularis*.

Types.—Syntypes, no. 3398 (complete specimen, male), no. 3399 (complete specimen, female), no. 3400 (right valve), no. 3401 (left valve). All specimens are from sample 3.

PYRICYTHEREIS SUBTRIANGULARIS
Sutton and Williams
Plate 42, figures 22–24;
plate 44, figures 9, 10

Pyricythereis subtriangularis Sutton and Williams, 1939, Jour. Paleontology, vol. 13, p. 569, pl. 64, figs. 11–13.
Pyricythereis alabamensis (Howe and Pyeatt) (part). Stephenson, 1944, idem, vol. 18, p. 453.

Carapace tumid, in side view elongate, subpyriform. Left valve larger than right, with strongest overlap at posterior cardinal angulation, and along ventral margin. Dorsal margin nearly straight and sloping to posterior, obscured in central portion by inflation of shell wall. Ventral margin weakly convex, somewhat sinuated in right valve, rising sharply toward posterior, often with several rudimentary spines near posteroventral angle. Anterior end high, broadly rounded, very weakly spinose on ventral half. Posterior end low, bluntly angular. A keel-like rim extends around and just inside anterior margin. About eight ribs diverge from near the posterior end and extend across about the posterior two-thirds of carapace, leaving the anterior third of shell wall smooth. A few poorly defined pits are irregularly disposed between the ribs.

Length (complete specimen, male) 0.71 mm., height 0.37 mm., width 0.33 mm. Length (complete specimen, female) 0.63 mm., height 0.39 mm., width 0.33 mm.

Remarks.—Two somewhat similar species, *P. alabamensis* and *P. subtriangularis* occur in the Weches and are distinguishable on the basis of surface sculpturing. In describing *P. subtriangularis*, Sutton and Williams (1939, p. 569) stated that "the surface of the carapace has a reticulate pattern of ridges, which intersect almost at right angles, producing a pitted appearance." This description more adequately defines the sculpturing of *P. alabamensis*. An examination of the type specimens (U. I. X-1249, X-1250, X-1251) indicates, however, that they are distinct from *P. alabamensis*. The ornamentation is much weaker, with almost no pitting, and much of the carapace is smooth.

Molt valves of this species, such as those figured (pl. 42, figs. 22, 23), are not uncommon in the Weches. A slender, carinate rim extends around the anterior end, with the shell wall smooth inside and adjacent to it. Tumid portion of these valves is ornamented with numerous slender ribs subparallel to outer periphery of shell. Areas between ribs show rows of fine pits with riblets tending to coalesce around them. A slender acicular spine projecting posteriorly is present near ventral margin at about one-fourth the shell length from posterior. The youngest molt observed (pl. 42, fig. 22) shows only two horizontal ridges, with remainder of tumid portion of carapace closely set with small, well-impressed, ovoid pits. The finer shell characters of these molt valves are identical with those defined by Howe (see Howe and Chambers, 1935, p. 22) for the genus *Buntonia*.

P. subtriangularis occurs in the Reklaw and Weches formations of Texas.

Types.—Hypotypes, no. 3402 (male), no. 3403 (female), from sample 3; nos. 3404, 3405 (right and left valves), nos. 3406, 3407 (molt valves), from sample 6.

Genus BRACHYCYTHERE Alexander, 1933

Cythereis (*Pterygocythereis*) Blake (part), of authors. (Blake, C., 1933, in Biological Survey of the Mount Desert Region, pt. 5, p. 239.)
Brachycythere Alexander, C. I., 1933, Jour. Paleontology, vol. 7, p. 204.
Alatacythere (part), Murray, G., Jr., and Hussey, K. M., 1942, idem, vol. 16, p. 169.
Genotype: *Cythere sphenoides* Reuss, A. E., 1854, Kais. Akad. Wissen Wien Denkschr. vol. 7, p. 141, pl. 26, fig. 2.

Carapace subquadrate to subovate, with left valve larger than right. Dorsal margin well arched, highest toward anterior. Ventral margin convex, often partially obscured by shell wall. Anterior end high, broadly and obliquely rounded, often denticulate. Posterior end lower, compressed, subangular to subacute, often spinose like anterior. Shell wall inflated ventrally, in some species with ventral alaeform expansions. Hinge struc-

ture in right valve consists of a knob-like anterior tooth with postjacent socket, followed by a furrow to the notched posterior tooth. In the left valve, hinge bears an anterior socket with a tooth behind it, to which is attached a bar which extends to the crenulated posterior socket. The bar is below the dorsal margin and separated from it by a depressed furrow. Marginal areas fairly broad, with numerous radial pore canals. Line of concrescence and inner margin coincide throughout. Muscle scar pattern of the genotype, *B. sphenoides* (Reuss), was figured by Alexander (1933, pl. 25, fig. 3c).

BRACHYCYTHERE ALATA
(Bosquet) Alexander
Plate 44, figures 12, 13, 24, 25;
plate 45, figure 26

Cypridina alata Bosquet, 1847. Mém. Soc. Royale Sci., Liége, vol. 4, p. 369, pl. 4, figs. 1 a–d.
Cythere cornuta (Roemer) var. *gulfensis* Alexander, 1929, Texas Univ. Bull. 2907, p. 85, pl. 8, figs. 1, 2, 6.
Brachycythere alata (Bosquet). Alexander, 1933, Jour. Paleontology, vol. 7, p. 207, pl. 25, figs. 15, a, b; pl. 27, fig. 18. Van Veen, 1935, Naturhist. Maandbl., vol. 24e, nos. 2–5, p. 6, pl. 3, figs. 8–12.
Alatacythere alata (Bosquet). Murray and Hussey, 1942, Jour. Paleontology, vol. 16, p. 171, pl. 27, figs. 13, 16–18; text fig. 1, figs. 11–18.

Carapace large, in side view subquadrate. Dorsal margin weakly arched, flattened along hinge line, sloping to posterior. Ventral margin slightly convex. Anterior end high, compressed, broadly and obliquely rounded, often somewhat irregular on ventral portion. Posterior end lower, compressed, bluntly angular, in some specimens faintly denticulated near postero-ventral angle. Carapace wall smooth. A strong alaeform projection starts near antero-ventral angle and becomes increasingly prominent to a point about one-fourth the shell length from posterior, where it abruptly ends in a short blunt spine inclined posteriorly in some specimens, or in the subacute termination of the ala in others. A rudimentary spine is present on posterior slope of ala. Hingement and finer shell characters typical for *Brachycythere*.

Length (right valve) 1.02 mm., height 0.52 mm., width 0.48 mm. Length (left valve) 1.05 mm., height 0.61 mm., width 0.52 mm.

Remarks.—*B. alata* has been rather widely reported. *Cythereis alata* (Bosquet) of Jones (1849, p. 21, pl. 5, figs. 14a–d) appears to be an entirely distinct species, possessing a much higher, heavier carapace, with a series of short, pointed spines on the posterior slope of the ala. *Cytheropteron saratogana* Israelsky (1929, p. 10, pl. 2A, figs. 4 a–c) probably should be included in synonomy under this species. It is a rare form in the Saratoga (Cretaceous) and I have no specimens. The rudimentary spine on the posterior alar slope, characteristic of Weches specimens, is absent from Cretaceous forms figured by Alexander (1929 and 1933) and van Veen (1935). My material conforms closely to the shell characters defined for *Brachycythere*, and there appear no grounds for its assignment by Murray and Hussey (1942, p. 171) to *Alatacythere*, a genus shown in the introduction of this paper to have been poorly defined. The species is not uncommon in the Weches, and occurs rarely in the Enterprise marl of Mississippi.

Types.—Hypotypes, no. 3408 (right valve), no. 3409 (left valve), from sample 3.

BRACHYCYTHERE BERNARDI
Murray and Hussey
Plate 44, figure 18;
plate 45, figure 22

Brachycythere bernardi Murray and Hussey, 1942, Jour. Paleontology, vol. 16, p. 176, pl. 28, figs. 7, 9; text fig. 2, figs. 14–16.

Carapace in side view elongate, subquadrate. Dorsal margin moderately arched, sloping to posterior. Ventral margin convex. Anterior end compressed, broadly and obliquely rounded. Posterior end compressed, bluntly truncated. Shell wall smooth. A strong ventral alaeform projection has its axis inclined posteriorly, and is terminated by a very short spine at about one-third the shell length from posterior.

Length (complete specimen) 0.89 mm., height 0.47 mm., width 0.68 mm. Length (right valve) 0.86 mm., height 0.45 mm. Length (left valve) 0.87 mm., height 0.50 mm.

Remarks. Murray and Hussey (1942, p. 177) failed to indicate a type locality for this species. It was reported from the Cane River of Louisiana and the Weches of Texas in their text, but is restricted to the Cane River on their range chart (p. 168). The ala

of my Cane River specimens from Natchitoches, Louisiana is not as pronounced or as pointed as on Weches specimens. The slender, acutely terminated ala of this species makes it an easily recognizable form. It occurs very rarely at Smithville.

Types.—Hypotypes, no. 3410 (complete specimen), no. 3411 (right valve), no. 3412 (left valve). All specimens are from sample 2.

BRACHYCYTHERE HADLEYI
Stephenson, n. sp.

Plate 44, figure 23; plate 45, figure 23

Carapace large, in side view elongate, subquadrate. Dorsal margin well arched, flattened along hinge line and sloping to posterior. Ventral margin convex, partially obscured by ala. Anterior end high, compressed, broadly and obliquely rounded. Posterior end low, compressed, tapered to bluntly rounded postero-ventral angle. Surface of valves smooth. Eyespot faintly visible, with shallow depression posterior and ventral to it. Central portion of carapace well inflated. Ventral ala well developed, having its inception at antero-ventral angle and extending as a keel-like ridge with flat crest, becoming increasingly prominent to a point about one-fourth the shell length from posterior. Ala is bluntly rounded at termination, and it recedes abruptly on its posterior slope. Radial and alar pore canals fairly straight, rather widely spaced. Hingement typical for genus.

Length (right valve) 0.93 mm., height 0.54 mm., width 0.34 mm. Length (left valve) 0.93 mm., height 0.58 mm., width 0.40 mm.

Remarks.—The ala of *B. hadleyi* is much more prominent than on *B. russelli*. It is considerably less pronounced, however, than the ala of *B. alata*, and lacks the acute termination of the wing-like expansions of that species. *B. hadleyi* has been observed only in the upper Viesca and lower Therrill members of the Weches at Smithville, where it is a rare form.

Named for Wade H. Hadley, Jr., geologist, Pure Oil Company, New Orleans, Louisiana.

Types.—Syntypes, no. 3413 (right valve), from sample 21; no. 3414 (left valve), from sample 7.

BRACHYCYTHERE MARTINI
Murray and Hussey

Plate 44, figure 21; plate 45, figure 24

Brachycythere martini Murray and Hussey, 1942, Jour. Paleontology, vol. 16, p. 177, pl. 28, figs. 6, 10; text fig. 2, figs. 4, 8–10.

Carapace in side view elongate, subovate. Dorsal margin moderately arched, more strongly so in larger left valve. Ventral margin convex. Anterior end obliquely rounded, sometimes bearing several short blunt spines. Posterior end lower, bluntly truncated to narrowly rounded postero-ventral angle, which is usually denticulated. Valves well inflated, smooth on peripheral area, their central portion exhibiting very weak anastomosing ridges producing a faint reticulate pattern. Ventral ala weakly developed, extending as a low carinate ridge convex ventrally across central portion of ventral slope of shell, terminating in a small very short, blunt spine at about one-third the shell length from posterior. A second less prominent ridge is present just ventral to the ala, with the shell wall steeply sloping below it.

Length (complete specimen) 0.93 mm., height 0.52 mm. width 0.60 mm.

Remarks.—This species is distinguished by its low anterior end and subovate outline, as well as by the characteristic weakly developed reticulate sculpturing. Murray and Hussey (1942, p. 178) reported *B. martini* to range from the Weches to the top of the Jackson. An occurrence in my collection not noted by them is from the Enterprise marl of the Claiborne of Mississippi.

Types.—Hypotypes, no. 3415 (complete specimen), from sample 7; no. 3416 (right valve), no. 3417 (left valve), from sample 5.

BRACHYCYTHERE RUSSELLI
Howe and Lea

Plate 44, figure 22; plate 45, figure 19

Brachycythere watervalleyensis Howe and Chambers (part), 1935, Louisiana Dept. Cons. Geol. Bull. 5, p. 46, pl. 3, fig. 4 (*not* pl. 3, figs. 1–3, 5, 6; pl. 4, fig. 1; pl. 6, fig. 7).

Brachycythere russelli Howe and Lea, 1936, in Howe and Law, idem, Bull. 7, p. 41, pl. 2, figs. 30, 31; pl. 3, figs. 23–25. Murray and Hussey, 1942, Jour. Paleontology, vol. 16, p. 178, pl. 28, figs. 1, 4, 5, 8; text fig. 1, figs. 19–24; text fig. 2, fig. 1.

Carapace large, in side view subquadrate.

Dorsal margin well arched, sloping to posterior. Ventral margin convex. Anterior end high, compressed, obliquely rounded. Posterior end lower, compressed, bluntly truncated. Surface smooth. Ventral ala weak, starting near antero-ventral angle and extending as a low, down-curved ridge inside ventral margin, arcing upward and becoming obscure near posterior end.

Length (right valve) 1.00 mm., height 0.59 mm., width 0.31 mm. Length (left valve) 0.91 mm., height 0.53 mm., width 0.31 mm.

Remarks.—This species is characterized by its high anterior end, smooth surface, and very weak ala which shows no tendency to increase in prominence toward posterior. Murray and Hussey (1942, p. 179) indicated the range of *B. russelli* to be Claiborne Eocene to Vicksburg Oligocene. The species is rare in the Weches at Smithville.

Types.—Hypotypes, no, 3418 (right valve), no. 3419 (left valve) from sample 6.

Genus CYTHEREIS Jones, 1849

Cythere Müller (part), of authors. (Müller, O. F., 1785, Entomostraca seu Insecta testacea, p. 63.)
Cythere (*Cythereis*) Jones, T. R. (part), 1849, A monograph of the Entomostraca of the Cretaceous formation of England, p. 14.
Cythereis Baird, W. (part), 1850, Natural history of the British Entomostraca, p. 174.
Archicythereis Howe, H. V. (part), 1936, in Howe, H. V., and Law, J., Louisiana Dept. Cons. Geol. Bull. 7, p. 57.
Genotype unselected.

Carapace subquadrate, highest anteriorly. Dorsal and ventral margins usually straight or weakly convex, normally converging posteriorly. Anterior end rounded, posterior end subangular, often denticulate on their ventral portions. Ornamentation exceedingly variable, including spines, pits or ridges, at times in various complex combinations. A subcentral inflated node anterior to middle of carapace, present on many species, is a feature stressed by earlier workers. Eyespot usually visible below anterodorsal angle, often prominent. Hinge structure normally well developed, in the right valve with strong teeth at the cardinal angles. A rounded socket postjacent to anterior tooth joins a groove which extends to posterior dentition. In the left valve, terminal sockets articulate with the teeth of the opposite valve. A knob-like swelling or tooth behind the anterior socket is attached to the dorsal margin, which margin continues as a bar to the posterior socket. Alexander (1933, p. 209) pointed out that the hinge of *Cythereis* differs from that of *Brachycythere* in that this bar is the dorsal edge of the valve, and is not below and distinct from it as in *Brachycythere*. Muscle-scar pattern is usually obscured by surface ornamentation.

As no genotype has been selected for *Cythereis*, it is rather difficult to assign species to it with certainty. Most recent workers, including the present author, have adhered to the definition of the genus given by Alexander (1933, p. 208), in which *Cythereis ornatissima* (Reuss) was considered a typical species of the genus.

CYTHEREIS BASTROPENSIS
Stephenson, n. sp.
Plate 45, figure 13

Carapace in side view elongate, subquadrate. Dorsal and ventral margins nearly straight, subparallel. Anterior end broadly and obliquely rounded, somewhat produced above dorsal margin, bearing a very short, blunt spine. Posterior end bluntly angular, convex and denticulated on ventral half. A thickened rim extends inside and parallel to anterior end. Eyespot small, distinct, spherical. Anterior and posterior ends and postero-ventral region compressed. A narrow ridge of irregular height along dorsal margin is most prominent toward posterior, with several short subsidiary extensions branching a short distance downward from it. A thickened irregular node at midpoint of shell height and anterior to middle is flanked posteriorly by a depressed area, immediately behind which is a slender, irregular, lateral ridge extending toward posterior. A third somewhat undulating ridge near ventral margin is partially broken into nodose projections. Remainder of shell wall is smooth, except for occasional small, blunt nodes.

Length (right valve) 0.86 mm., height 0.40 mm. Length (left valve) 0.92 mm., height 0.44 mm.

Remarks.—This species is closely related to *C. orelliana*, differing from it in being almost smooth, with the reticulate pattern of fine ridges and spines absent. The lateral ridges are much more slender and less pro-

nounced than on *C. reklawensis* Stephenson (1944, p. 451, pl. 76, fig. 14), from the Reklaw formation.

Types.—Syntypes, no. 3420 (right valve), no. 3421 (left valve), from sample 3.

CYTHEREIS BURSILLOIDES Stadnichenko
Plate 45, figures 14–17

Cythereis bassleri Ulrich. Cushman, 1925, Am. Assoc. Petroleum Geologists, Bull., vol. 9, p. 302, pl. 8, figs. 3a–c.
Cythereis bursilloides Stadnichenko, 1927, Jour. Paleontology, vol. 1, p. 239, pl. 39, figs. 21–23. Sutton and Williams, 1939, idem, vol. 13, p. 567, pl. 63, figs. 7–9. Gooch, 1939, idem, vol. 13, p. 583, pl. 67, figs. 12, 13.

Carapace tumid, in side view subquadrate. Dorsal margin nearly straight, strongly arched around the high antero-cardinal angle; v ntral margin straight to slightly sinuated. Anterior end bluntly and obliquely rounded, weakly denticulated on ventral half, with a thickened rim just inside periphery. Posterior end compressed, steeply truncated to bluntly angular postero-ventral angle, which usually carries several very short spines. Eyespot well developed. Entire surface ornamented with a series of more or less horizontal curvilinear ridges. Of these ridges, two tend to be more prominent: one near ventral margin terminates about one-fourth the shell length from posterior in a sculptured node, the other near dorsal margin arcs upward to vicinity of postero-cardinal angle. Areas between ridges carry rather strong pits of moderate size. Central portion of shell wall anterior to midpoint is inflated, with sculpturing continuous across it.

Length (complete specimen) 0.71 mm., height 0.42 mm., width 0.39 mm. Length (first known molt) 0.35 mm., height 0.18 mm. Length (second known molt) 0.54 mm., height 0.28 mm. Length (third known molt) 0.60 mm., height 0.33 mm.

Remarks.—Cushman (1925) identified this species as *C. bassleri* Ulrich (1901, p. 120) in his Claiborne material from Mexico. I have a single specimen from his Moctezuma River locality which agrees closely with topotype specimens of *C. bursilloides* Stadnichenko from the Cook Mountain of Texas. It appears, however, that Ulrich's species from the Maryland Eocene is a lower form which exhibits a much weaker development of ridges. In his study of Claiborne species of *Cythereis* from Louisiana, Gooch (1939, p. 583, pl. 67, fig. 12) unfortunately figured only a specimen from the Cook Mountain of Texas. My specimens from the Cook Mountain at Columbus, Louisiana show a strong development of ridges and pits, with the crests of ridges narrow and angular, and the ventral ridge carinate and laterally expanded at its posterior extremity.

Three molt stages of this species have been found in the Weches material. The first known molt is small, fragile, low and elongate. A faint network of delicate ridges covers the surface. The subcentral node is clearly visible, while the ventral ridge is weakly developed, its posterior end marked by a slender spine. A carinate rim outlines anterior end. The second known molt is much larger, and there is probably a hiatus in the series between it and the smaller carapace. The reticulate pattern of ridges is much stronger, with the ventral ridge clearly visible and thickened on posterior, from which a less prominent slender ridge extends obliquely to postero-cardinal angle, thence laterally toward anterior. The third known molt is slightly longer and much higher, particularly on posterior. The reticulate ridges remain slender, outlining subangular depressions which are much larger than in preceding molt. Subcentral node is a low broadened expansion. Dorsal and ventral ridges are most prominent toward posterior, where there is no continuous connecting ridge joining them. This third molt exhibits the same pattern of external characters as the adult, except that the carapace is smaller, more fragile, and the ornamentation more delicate. Hinge structure of these molt valves is weakly developed, in the right valve with elongate, faintly notched dental areas at the cardinal angles, connected by a slender groove which tends to be very weakly crenulate. Terminal sockets in left valve are poorly developed, with the slender dorsal margin between them showing a tendency toward weak crenulations. The shell characters of these molt valves are identical with those described for the genus *Archicythereis* Howe (see Howe and Law, 1936, p. 57). They are readily identifiable as young forms of *C. bursilloides*, however, and are here included with the adults.

Described from the Cook Mountain of Texas, *C. bursilloides* is present in that formation at Columbus, Louisiana. It likewise occurs in the Lisbon (Claiborne Eocene) of Alabama, and is rare in the Claiborne on Moctezuma River, Mexico.

Types.—Hypotypes, no. 3422 (complete specimen), from sample 4; nos. 3423, 3424, 3425 (first, second, and third known molts), from sample 3.

CYTHEREIS CLAIBORNENSIS Gooch
Plate 45, figure 4

Cythereis claibornensis Gooch, 1939, Jour. Paleontology, vol. 13, p. 581, pl. 67, figs. 5, 6, 10.

Carapace small, rather compressed, in side view elongate, subquadrate. Dorsal margin nearly straight, somewhat produced around antero-cardinal angle, sloping very gently to posterior. Ventral margin straight, slightly convex near antero-ventral angle. Anterior end broadly and evenly rounded with a low thickened rim around it; ventral portion of anterior end usually armed with a number of very short, fine spines. Posterior end slightly lower, compressed, bluntly angular, bearing several short spines. Eyespot small, distinct. Surface of carapace covered with numerous rather small ovoid pits tending to be arranged in horizontal rows, the areas between pits standing in relief and forming a reticulate pattern. A more prominent irregular ridge near dorsal margin is prominent at postero-cardinal angle, where it is abruptly extended downward across carapace wall. A second horizontal ridge inside and subparallel to ventral margin is terminated about one-fourth the shell length from posterior. A subcentral node is situated somewhat anterior to midpoint of shell.

Length (right valve) 0.58 mm., height 0.28 mm. Length (left valve) 0.58 mm., height 0.30 mm.

Remarks.—In spite of the small size of this species, it appears to be an adult form. Gooch (1939, p. 582) observed that numerous molts were present in the type material, and figured a valve in an early molt stage (pl. 67, fig. 6). Originally reported from the Cook Mountain formation of Louisiana, the species is rare in the Weches. A few specimens are present in my collection from the Cane River formation of Louisiana, the Enterprise marl of Mississippi, and the Lisbon of Alabama. These occurrences are all in Claiborne sediments.

Types.—Hypotypes, no. 3426 (right valve), no. 3427 (left valve), from sample 3.

CYTHEREIS CLAIBORNIANA
(Stadnichenko) Stephenson
Plate 45, figure 25

Cythere claiborniana Stadnichenko, 1927, Jour. Paleontology, vol. 1, p. 234, pl. 39, fig. 19.
Pyricythereis foveovalva Sutton and Williams, 1939, idem, vol. 13, p. 567, pl. 64, figs. 29, 30.

Carapace tumid, in side view low, elongate, subquadrate. Dorsal margin nearly straight, subparallel to somewhat indented ventral margin. Anterior end broadly and obliquely rounded with a low, slightly thickened rim; ventral portion of anterior end occasionally shows a series of short, very fine spines. Posterior end slightly lower, bluntly angular, often weakly denticulate on ventral half like anterior. Eyespot just below antero-cardinal angle poorly defined. Entire surface covered with shallow, weakly impressed, angular pits of moderate size, which tend to be aligned parallel to periphery on anterior, ventral and posterior slopes. Hingement typical for *Cythereis* except for the very faint crenulation of hinge groove of right valve and articulating bar of left valve.

Length (complete specimen) 0.68 mm., height 0.33 mm., width 0.30 mm.

Remarks.—This species shows a slight crenulation of the hinge line, a feature which no doubt influenced Sutton and Williams (1939, p. 567) to place the species in the genus *Pyricythereis*. Shape of the carapace and lack of strong overlap at the postero-cardinal angle lead me to include this species under *Cythereis*.

Types.—Hypotypes, no. 3428 (complete specimen), no. 3429 (right valve), no. 3430 (left valve). All specimens are from sample 5.

CYTHEREIS DAVIDWHITEI Stadnichenko
Plate 44, figure 5; plate 45, figure 12

Cythereis davidwhitei Stadnichenko, 1927, Jour. Paleontology, vol. 1, p. 240, pl. 39, fig. 24.
Cythereis quinquespinosa Sutton and Williams, 1939, idem, vol. 13, p. 566, pl. 63, figs. 10, 11.

Carapace of male in side view elongate, subquadrate. Dorsal and ventral margins nearly straight, somewhat converging to posterior. Anterior end broadly and evenly rounded and bearing a series of short, blunt

spines. Posterior end narrower, bluntly angular, usually armed with several acicular spines. A small but pronounced eyespot is visible below antero-cardinal angle. A thickened rim around anterior end is set with a number of blunt spines along its narrow crest, with shell wall depressed behind it. Several spines are present on posterior portion of dorsal margin and projected above it, with a strong group of spines, which often coalesce, in an arcuate row downward from vicinity of postero-cardinal angle. Shell wall smooth and polished, with only a few long spines which usually have bluntly truncated ends, and sometimes tend to divide. A pronounced clump of spines is sometimes developed near postero-ventral angle.

Length (complete specimen) 0.78 mm., height 0.40 mm., width 0.39 mm.

Remarks.—This species is rather easily distinguished by its ornamentation, consisting of a limited number of long, bluntly terminated spines. I have examined the holotype of *C. quinquespinosa* (U. I. X-1238) and found it to be the right valve of a female carapace of *C. davidwhitei*. Described from the Cook Mountain formation of Texas, the species is fairly common in the Weches. Additional occurrences in my collection are from the Cook Mountain of Louisiana and the Lisbon of Alabama.

Types.—Hypotypes, no. 3431 (complete specimen), no. 3432 (right valve), no. 3433 (left valve). All specimens are from sample 3.

CYTHEREIS ELMANA Stadnichenko
Plate 44, figure 1; plate 45, figure 8

Cythereis elmana Stadnichenko, 1927, Jour. Paleontology, vol. 1, p. 240, pl. 39, fig. 20.
Cythereis sinuata Sutton and Williams, 1939, idem, vol. 13, p. 565, pl. 63, figs. 15–17.
Cythereis elmana Stadnichenko. Stephenson, 1944, idem, vol. 18, p. 451, pl. 76, fig. 13.

Carapace tumid, in side view subquadrate. Dorsal margin nearly straight, obscured by shell wall, sloping gently to posterior. Ventral margin somewhat convex in larger left valve, sinuated in right valve. Anterior end broadly and evenly rounded, bearing a series of very short, blunt spines. Posterior end bluntly angular, denticulated on ventral half as on anterior. A thickened rim extends around anterior end from a point just behind antero-cardinal angle, broken by obscure eyespot. A low, rounded ridge obscures the dorsal margin, extending from a depression behind antero-dorsal angle to postero-dorsal angulation. A crescentic inflation, convex anteriorly, occupies anterior portion of shell wall, with an elongated depression separating it from anterior rim. Two horizontally elongated, rounded, irregular inflations extend toward posterior from limbs of anterior inflation, separated from it by transverse depressions. Shell wall smooth.

Length (complete specimen) 0.83 mm., height 0.47 mm., width 0.41 mm. Length (right valve) 0.82 mm., height 0.44 mm. Length (left valve) 0.84 mm., height 0.49 mm.

Remarks.—*C. elmana* may be easily identified by the low, rounded lobes ornamenting the exterior. *C. viescana*, n. sp., an allied form found only in the upper Viesca and Therrill members, exhibits a stronger inflation of the valves, and the characteristic lobes on *C. elmana* are wanting. A variant of *C. elmana* (see Stephenson, 1944) occurs in the Reklaw, and is included with the typical form. The species was described from the Cook Mountain formation of Texas, where it is rare.

Types.—Hypotypes, no. 3434 (complete specimen), no. 3435 (right valve), no. 3436 (left valve). All specimens are from sample 3.

CYTHEREIS ELONGATA Sutton and Williams
Plate 45, figure 2

Cythereis? elongata Sutton and Williams, 1939, Jour. Paleontology, vol. 13, p. 565, pl. 64, figs. 31–33.

Carapace rather small, in side view low, elongate, subquadrate. Dorsal margin weakly arched, gently sloping to posterior. Ventral margin indented at middle. Anterior end broadly rounded, showing faint traces of rudimentary spines. Posterior end slightly lower, compressed, bluntly angular. Eyespot small, faintly visible. A low, poorly defined ridge outlines dorsal border. A more prominent ridge extends from a point anterior to center of the shell, obliquely upward across wall toward postero-cardinal angle, but becomes obscure before reaching it. Shell surface granular, with irregularly dis-

persed, small, weakly impressed pits. Hingement typical for *Cythereis*, except for slight tendency toward crenulation of the groove and bar.

Length (complete specimen) 0.54 mm., height 0.28 mm., width 0.24 mm.

Remarks.—This species is somewhat similar to *C. claiborniana* but is smaller, has weaker, poorly defined pitting, and an oblique rib across the carapace wall. *C. elongata* is very rare in the upper Viesca member of the Weches.

Types.—Hypotype, no. 3437 (complete specimen), from sample 19.

CYTHEREIS EVERGREENICA (Stadnichenko) Stephenson

Plate 44, figures 16, 17; plate 45, figure 6

Cythere evergreenica Stadnichenko, 1927, Jour. Paleontology, vol. 1, p. 235, pl. 39, fig. 25.

Carapace tumid, in side view elongate, subovate. Dorsal margin weakly arched, sloping very gently to posterior. Ventral margin nearly straight, slightly indented. Anterior end broadly rounded; posterior end produced to more narrowly rounded posteroventral angle. Valves well and evenly inflated, of smooth texture. A series of low, rounded, more or less horizontal, curvilinear ribs extends across shell wall, some of them bifurcating and continuing as two ribs. Ornamentation is reduced and almost entirely wanting on some specimens. Hinge structure (pl. 44, figs. 16, 17) typical for genus.

Length (complete specimen) 0.88 mm., height 0.45 mm., width 0.42 mm. Length (right valve) 0.91 mm., height 0.44 mm. Length (left valve) 0.91 mm., height 0.45 mm.

Remarks.—The low, horizontal ribs on this species readily place it specifically. It may be separated from *Cytheretta tyusensis*, n. sp., a rare Weches species of rather similar appearance, by shape and overlap of the valves and lack of the inner margin characteristic of *Cytheretta*. *Cythereis evergreenica* was originally described from a single specimen from the Cook Mountain formation of Texas. The ten specimens in my collection, from the type locality at Evergreen Crossing in Lee County, are somewhat smaller than Weches representatives, with an identical but more weakly developed ornamentation. I have a single specimen from the Claiboune on Moctezuma River, State of Vera Cruz, Mexico.

Types.—Hypotypes, no. 3438 (complete specimen), no. 3439 (right valve), no. 3440 (left valve). All specimens are from sample 3.

CYTHEREIS LINOSPINOSA Sutton and Williams

Plate 45, figure 18

Cythereis linospinosa Sutton and Williams, 1939, Jour. Paleontology, vol. 13, p. 566, pl. 63, figs. 5, 6.

Carapace in side view elongate, subquadrate. Dorsal and ventral margins nearly straight, slightly converging toward posterior. Anterior end broadly rounded, weakly denticulate. Posterior end compressed, bluntly truncated and subangular. A thickened rim extends around anterior end, showing several node-like projections on ventral portion. A ridge occupies dorsal margin of shell, showing a scalloped crest and indented carving of flanks. A thickened area of shell wall anterior to center consists of a clump of coalesced spines with rounded extremities, posterior to which is a narrow, irregular ridge carrying short, blunt spines. A third horizontal ridge outlines ventral border, and consists of coalesced spines. A few low spines and nodes are present between ridges.

Length (right valve) 0.80 mm., height 0.43 mm. Length (left valve) 0.83 mm., height 0.48 mm.

Remarks.—The nodes ornamenting this species tend to be concentrated along dorsal and ventral margins and through the center of the carapace. It is similar to *C. wechesensis*, but lacks the elongated nodes on the ventral slope of that species. The original syntypes (U. I. X-1236, X-1237) have been examined by the author.

Types.—Hypotypes, no. 3441 (right valve), no. 3442 (left valve), from sample 3.

CYTHEREIS ORELLIANA (Stadnichenko) Stephenson

Plate 45, figure 20

Cythere orelliana Stadnichenko, 1927, Jour. Paleontology, vol. 1, p. 236, pl. 39, figs. 8–10.

Cythereis sabinensis Howe and Garrett, 1934, Louisiana Dept. Cons. Geol. Bull. 4, p. 55, pl. 4, figs. 16, 17.

Cythereis smithvillensis Sutton and Williams,

1939, Jour. Paleontology, vol. 13, p. 564, pl. 63, figs. 18–20.

Carapace in side view elongate, subquadrate. Dorsal and ventral margins nearly straight, slightly converging posteriorly. Anterior end broadly and obliquely rounded, armed with short, blunt spines. Posterior end bluntly angular, denticulated like anterior. A thickened rim extends around anterior end, with nodes or short spines along its crest. A subcentral carved expansion is present anterior to center. Dorsal margin bordered with a low ridge, often with low, blunt spines extending above it. Surface covered with numerous short spines, connected by an intricate network of low, slender ridges. The ridges form a reticulate pattern with angular depressions between them.

Length (complete specimen) 0.84 mm., height 0.42 mm., width 0.37 mm.

Remarks.—*C. orelliana* is characterized by the fine network of reticulate ridges on its exterior. This feature was described by Howe and Garrett for *C. sabinensis* from the Wilcox. Some Wilcox specimens from Sabinetown, Texas, show ornamentation identical with that of specimens from the Cook Mountain localities of Stadnichenko; on others the ridges are less pronounced and less threadlike. Rare specimens from the Reklaw of Texas are smaller than those from the type locality, but are entirely typical. The species is well developed and usually common in the Weches, where it was described by Sutton and Williams as *C. smithvillensis*. It is present in the Cane River formation at Natchitoches, Louisiana, and rare in the Cook Mountain of Winn Parish. In Alabama, it occurs in the Wilcox group in the Tuscahoma formation at Greggs Landing on Alabama River, and the Hatchetigbee formation at Hatchetigbee Bluff on Tombigbee River, as well as in the Lisbon (Claiborne Eocene) at Claiborne Bluff on Alabama River. It occurs rarely in the Enterprise marl on Chickasawhay River at West Enterprise, Mississippi. The range of *C. orelliana* is therefore Wilcox Eocene to the Cook Mountain formation of the Claiborne group.

Types.—Hypotypes, no. 3443 (complete specimen), no. 3444 (right valve), no. 3445 (left valve). All specimens are from sample 3.

CYTHEREIS RUSSELLI Howe and Garrett
Plate 45, figure 1

Cythereis? russelli Howe and Garrett, 1934, Louisiana Dept. Cons. Geol. Bull. 4, p. 54, pl. 4, fig. 11.
Cythereis fragillissima Sutton and Williams, 1939, Jour. Paleontology, vol. 13, p. 565, pl. 63, figs. 21, 22.
Cythereis russelli Howe and Garrett. Stephenson, 1944, idem, vol. 18, p. 451, pl. 76, fig. 15.

Carapace rather fragile, in side view subquadrate. Dorsal margin weakly sinuated, sloping gently to posterior. Ventral margin nearly straight, rising toward posterior. Anterior end broadly rounded, weakly denticulated. Posterior end lower, bluntly angular, with several short spines in vicinity of postero-ventral angle. Eyespot small, distinct. Surface closely covered with rather small, subangular depressions, with a fine network of slender ridges separating them and standing in relief to form a reticulate pattern. Depressions arranged in several rows subparallel to periphery adjacent to anterior end. Hingement delicate, showing very faint crenulation of hinge bar and groove, with posterior tooth of right valve showing several weakly defined cusps. Inner marginal areas narrow, in some specimens nearly entirely wanting.

Length (right valve) 0.70 mm., height 0.35 mm. Length (left valve) 0.63 mm., height 0.36 mm.

Remarks.—This rather fragile species exhibits a delicate reticulate ornamentation, with slender, faintly crenulated hinge, and narrow interior marginal zones. These shell characters are common to carapaces representing a molt stage, and it may be that *C. russelli* is not a fully developed form. No species is present in the Weches, however, which appears to represent a more mature stage than that figured. Occasional valves indicate the existence of young molts of this species. The carapaces of these specimens are smaller and more delicately ornamented, sometimes showing an intricate web of closely spaced, extremely fine ridges. A short spine is usually present on these young specimens, and some valves bear numerous short, very fine spines over the shell wall.

Occurrence.—*C. russelli* was described from the Wilcox at Sabinetown, Texas, and it likewise occurs in the Reklaw, Weches,

and Cook Mountain formations. It is present in the Cook Mountain of Louisiana, where many specimens are delicately spinose. It likewise occurs in my collections from Alabama in the Hatchetigbee (Wilcox) and Lisbon (Claiborne) formations.

Types.—Hypotypes, no. 3446 (right valve), no. 3447 (left valve), from sample 3.

CYTHEREIS SPLENDENS Sutton and Williams

Plate 44, figure 6; plate 45, figure 10

Cythereis splendens Sutton and Williams, 1939, Jour. Paleontology, vol. 13, p. 563, pl. 63, figs. 12–14.

Carapace in side view subquadrate. Dorsal margin nearly straight and sloping to posterior, with nodes and short spines projecting above it. Ventral margin fairly straight, arcing strongly upward toward posterior. Anterior end broadly rounded, weakly denticulated. Posterior end somewhat lower, bluntly angular, faintly spinose. A heavy thickened rim with nodes on its crest extends around anterior end. A subcentral, irregular clump of spines, with their bases coalesced, is present anterior to middle. Surface shows a limited number of nodes and short blunt spines.

Length (complete specimen) 0.84 mm., height 0.50 mm., width 0.44 mm. Length (right valve) 0.78 mm., height 0.42 mm. Length (left valve) 0.86 mm., height 0.51 mm.

Remarks.—This species is characterized by the limited number of short spines and nodes, which are fairly evenly disposed on the shell wall. The primary types have been examined by the author. *C. splendens* is a rather rare form in the Weches at Smithville.

Types.—Hypotypes, no. 3448 (complete specimen), no. 3449 (right valve), no. 3450 (left valve). All specimens are from sample 3.

CYTHEREIS STENZELI Stephenson, n. sp.

Plate 45, figure 5

Cythereis hilgardi Howe and Garrett. Stephenson, 1944, Jour. Paleontology, vol. 18, p. 450, pl. 76, fig. 11.

This species was defined from Reklaw Eocene material. The original description (Stephenson, 1944, p. 450) is quoted.

Carapace subrhomboidal, somewhat higher anteriorly. Anterior end broadly and obliquely rounded, bearing blunt spines, which are more prominent toward the ventral margin. Posterior end lower, pointed, denticulate on its ventral half. Dorsal and ventral margins nearly straight and converging somewhat toward the posterior, often in part obscured by surface ornamentation. Eyespot rather small but distinct, from which a strong marginal rim extends around the anterior end, the rim having a sharp crest except where broken by short spines toward the ventral margin. A short distance behind the eyespot a spinose ridge follows and obscures the dorsal margin, abruptly angling vertically downward a short distance at the posterocardinal angle, where it forms a crested projection. A short, slender, spinose, horizontal ridge occupies a median position posterior to the center, with a depressed area anterior to it and separating it from an irregular, closely grouped clump of spines. A lower carinate, fluted, faintly spinose ridge extends downward in a concave arc, at times partially obscuring the ventral margin. Remainder of carapace wall is covered with scattered short, rather slender spines, between which is a reticulate pattern of low, intersecting ridges.

Length (right valve) 0.79 mm., height 0.44 mm. Length (left valve) 0.80 mm., height 0.49 mm.

Remarks.—Specimens of this species from the Reklaw were assigned to *C. hilgardi* Howe and Garrett by the present author. Further study of Wilcox material indicates that *C. hilgardi* is much more weakly ornamented, and the strong, angular, spinose dorsal ridge which angles downward from the vicinity of the postero-cardinal angle on *C. stenzeli* is very weak on Wilcox material. Due to these differences in ornamentation, it seems desirable to separate the two forms.

Named for H. B. Stenzel, of Austin, Texas, for his helpful suggestions on the exposures at Smithville.

Types.—Syntypes, no. 3451 (right valve), no. 3452 (left valve), from sample 8.

CYTHEREIS SUTTONI Stephenson, new name

Plate 45, figure 7

Pyricythereis smithvillensis Sutton and Williams, 1939, Jour. Paleontology, vol. 13, p. 568, pl. 64, figs. 16–19.

Carapace tumid, in side view low, elongate, subquadrate. Left valve larger than right, with slight overlap around entire periphery except at postero-ventral angle. Dorsal and ventral margins nearly straight, converging toward posterior. Anterior end

high, obliquely rounded, usually bearing very short, blunt spines on ventral half. Posterior end lower, angular, faintly denticulate near postero-ventral angle. Surface ornamented by a series of low, rounded curvilinear ribs which tend to converge on anterior and posterior. On inflated central portion of carapace, a limited number of rather small, shallow, ovoid depressions between the ribs are embraced by faint cross riblets. Ornamentation becomes obscure near periphery, and on some specimens is almost entirely wanting.

Length (complete specimen) 0.66 mm., height 0.33 mm., width 0.32 mm.

Remarks.—The low, elongate outline of this species, together with the ribbed ornamentation, make it easily recognizable. Placed under *Pyricythereis* by Sutton and Williams, the groove in the hinge line of the right valve and articulating bar in the left valve are very finely crenulated. The left valve overlaps the right only slightly at the postero-cardinal angle, however, and the shell characters do not conform closely to those defined for *Pyricythereis*. The species is here assigned to *Cythereis* under the new name *C. suttoni*, as *C. smithvillensis* is preoccupied (see Sutton and Williams, 1939, p. 564).

C. suttoni is moderately common in the Weches, and occurs in the Cook Mountain formation at Evergreen Crossing in Lee County. It is present in the Cook Mountain of Louisiana in Winn Parish, and in Sabine Parish at Columbus on Sabine River, where most specimens are weakly ornamented.

Named for A. H. Sutton, of the University of Illinois, senior author of the species.

Types.—Hypotypes, no. 3453 (complete specimen), no. 3454 (right valve), no. 3455 (left valve). All specimens are from sample 3.

CYTHEREIS THERRILLENSIS Stephenson, n. sp. Plate 45, figure 21

Carapace thick, in side view elongate, subquadrate. Dorsal margin weakly arched, nearly straight and horizontal, partially obscured by ornamentation. Ventral margin fairly straight, in right valve indented near anterior, then convex, and rising steeply at posterior. Anterior end broadly rounded, armed with very short, node-like spines. Posterior end nearly as high as anterior, bluntly angular, weakly denticulate. Dorsal margin outlined by an irregular, scalloped ridge, with flanks carved by depressions. Anterior end encircled by a low rim, its crest showing low nodes on ventral half. An irregular, sculptured inflation is present anterior to middle, with a depression behind it, posterior to which is a short, irregular, horizontal, angular ridge. A short spine is often developed on postero-ventral slope. Surface strongly sculptured with rather closely spaced ovoid to subangular depressions of moderate size and depth.

Length (right valve) 0.75 mm., height 0.43 mm. Length (left valve) 0.77 mm., height 0.48 mm.

Remarks.—The heavy shell and massive reticulation of its surface distinguish this species. It is found in the uppermost Viesca and ranges into the Therrill member. The species is likewise present in the Cane River formation of Louisiana.

Types.—Syntypes, no. 3456 (right valve), no. 3457 (left valve), from sample 21.

CYTHEREIS UPTONENSIS Stephenson Plate 45, figure 3

Cythereis uptonensis Stephenson, 1944, Jour. Paleontology, vol. 18, p. 451, pl. 76, fig. 9.

The original description of the species, from Reklaw Eocene specimens, is here quoted.

Carapace small, elongate, subquadrate, highest anteriorly. Anterior end broadly and evenly rounded, armed with fine, short spines; posterior end narrower, compressed, bluntly angular. Dorsal and ventral margins nearly straight, converging somewhat toward the posterior. Eyespot small, rather obscure, a slender, keellike marginal rim extends from it around the anterior end, with the shell wall excavated inside it. A low, thickened rim outlines the posterior end. A narrow rounded ridge parallels the dorsal margin and abruptly angles downward onto the shell wall a short distance at the posterior cardinal angle. Inside and subparallel to the ventral margin is a shorter, less prominent ridge. Remainder of carapace wall is smooth.

Length (complete specimen) 0.49 mm., height 0.26 mm., width 0.19 mm.

Remarks.—This species is believed to be an adult form in spite of its small size. Weches specimens are somewhat larger than the types from the Reklaw, and while the ventral ridge is reduced, it is visible on some specimens.

Types.—Hypotype, no. 3458 (complete specimen), from sample 12.

CYTHEREIS VIESCANA Stephenson, n. sp.
Plate 44, figure 2; plate 45, figure 11

Carapace tumid, in side view subquadrate. Dorsal and ventral margins weakly convex, converging somewhat toward posterior. Anterior end broadly rounded, produced around the high antero-cardinal angle in the larger left valve, armed with short, blunt spines. Posterior end lower, tapered to blunt postero-ventral angle, weakly denticulate on ventral portion. Shell wall smooth. Valves well inflated, usually overhanging and partially obscuring ventral margin. A low, thickened rim around anterior end has a well-incised furrow inside it which is continuous with a broadened depressed area just below and extending posterior to weakly developed eyespot.

Length (complete specimen) 0.75 mm., height 0.45 mm., width 0.43 mm. Length (right valve) 0.75 mm., height 0.41 mm. Length (left valve) 0.76 mm., height 0.46 mm.

Remarks.—This species appears to have been derived from *C. elmana*, from which it may be distinguished by its greater inflation, and the smooth shell wall devoid of the lobes characteristic of *C. elmana*. *C. viescana* was encountered only in the uppermost Viesca and Therrill members, which precludes the possibility of the shell characters being due to sexual differences, as *C. elmana* ranges down through the Viesca and into the Tyus.

Types.—Holotype, no. 3459 (complete specimen); Paratypes, no. 3460 (right valve), no. 3461 (left valve). All specimens are from sample 21.

CYTHEREIS WECHESENSIS Sutton and Williams
Plate 45, figure 9

Cythereis spinosa Sutton and Williams 1939, (*not* Lienenklaus, 1900), Jour. Paleontology, vol. 13, p. 563, pl. 63, figs. 1–4.
Cythereis wechesensis Sutton and Williams, 1940, idem, vol. 14, p. 163.

Carapace in side view subquadrate. Dorsal margin weakly arched, produced around high antero-cardinal angle in left valve. Ventral margin nearly straight, somewhat indented in right valve. Anterior end broadly rounded, usually bearing very short, blunt spines. Posterior end bluntly angular, weakly denticulate on ventral slope. A thickened rim around anterior end has its crest broken by several low nodes on ventral half. An irregular subcentral expansion anterior to middle carries low nodes, and the depression posterior to it is followed by a short, rounded, irregular, horizontal ridge. Most of dorsal margin is outlined by a low, broken ridge. A few low nodes are present on carapace wall. A row of rounded, elongate nodes starts near the antero-ventral angle and extends obliquely across ventral slope toward posterior, with axes of nodes elongated normal to direction of the row.

Length (complete specimen) 0.82 mm., height 0.46 mm., width 0.44 mm. Length (right valve) 0.82 mm., height 0.42 mm. Length (left valve) 0.80 mm., height 0.47 mm.

Remarks.—The ornamentation of this species is reduced to low, rounded protuberances. The oblique row of elongate nodes along the ventral slope is a useful criterion for specific identification of this form. These elongate nodes are particularly well developed on the left valve specimen of the original types (paratype, U. I. X-1224), which was among the specimens made available to the author through the courtesy of Harold W. Scott of the University of Illinois. *C. wechesensis* is a moderately common form in the Weches formation at Smithville.

Types.—Hypotypes, no. 3462 (complete specimen), no. 3463 (right valve), no. 3464 (left valve). All specimens are from sample 3.

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GLYPTOBAIRDIA, A NEW GENUS OF OSTRACODA[1]

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ABSTRACT—A new ostracode genus, *Glyptobairdia*, is described, with *G. bermudezi* Stephenson, n. sp., from the Recent of Cuba, designated as genotype.

INCLUDED in a group of Ostracoda which I recently described (Stephenson, 1944) from subsurface middle Tertiary beds of Texas was a species defined as *Bairdia? crumena* Stephenson. This species bears some affinities to the genus *Bairdia* McCoy (1844), but likewise departs from that genus in its sculptured exterior and the development of a dentate hingement similar to some of the genera of the family Cytheridae. Material from the Recent off the coast of Cuba, in an excellent state of preservation, has yielded a similar but distinct species, the shell characters of which may be more clearly determined. These Recent specimens have formed the basis for the new genus *Glyptobairdia* herein described.

I am deeply grateful to Pedro J. Bermudez, of the Standard Oil Company of Cuba, Habana, who sent me the type material and later generously supplemented it with additional specimens of *Glyptobairdia bermudezi* Stephenson, n. sp. My thanks are likewise extended to Henry V. Howe, of Baton Rouge, Louisiana, who very kindly consented to criticize the manuscript, and forwarded several specimens of an additional species referable to the new genus from the Red Bluff Oligocene of Mississippi.

Type specimens will be deposited in the Louisiana State University Museum, Baton Rouge, Louisiana.

SYSTEMATIC DESCRIPTIONS

Order OSTRACODA Latreille
Suborder PODOCOPA Sars
Family BAIRDIIDAE Sars, 1887
Genus GLYPTOBAIRDIA Stephenson, new genus

Genotype: *Glyptobairdia bermudezi* Stephenson, n. sp.

The carapace of members of this genus is rather heavy, in side view tending toward a subrhomboidal outline. Valves dissimilar, the left being larger, only slightly longer than the right, but overlapping it strongly along the dorsal margin. Surface sculptured. Viewed from the inside, valves deep. Hinge structure in the right valve consists of elevated, angular teeth at the cardinal angles, truncated into a bar between them which is depressed in its central portion. A well defined furrow separates the bar from the dorsal margin. In the left valve, hinge bears terminal sockets. well incised into the margin of the valve, and partially obscured by overlying encasing folds of the dorsal margin. A bar between and somewhat below the sockets is most prominent at its center, from which it slopes gradually into the socket areas. Above the bar and continuous with the sockets is a depressed area. Marginal areas moderately broad, bearing numerous simple radial pore canals. Line of concrescence is near outer margin of carapace. Muscle-scars are about eight in number, arranged in a more or less circular rosette.

Remarks.—The general shape and muscle scar pattern exhibited by this genus are much like the genus *Bairdia*. The ornamented exterior and rather complex hingement, however, definitely set it apart from that genus. These same two factors serve to differentiate it from the genus *Bairdoppilata* Coryell, Sample and Jennings (1935), which genus is without ornamentation, and possesses a hinge line with a series of terminal teeth and sockets in each valve. Henry V. Howe has suggested[2] that these specimens, which exhibit a muscle scar pattern similar to *Bairdia*, are probably best placed in the *Bairdiidae*, and the genus is here included under that family.

In addition to the genotype, *G. bermudezi*, from the Recent of Cuba, two other species of the new genus are known. *G. howei*, n. sp., occurs in the Oligocene of Mississippi. *G. crumena* (Stephenson) (1944, p. 156) was

[1] Published with the permission of the Stanolind Oil and Gas Company.

[2] Personal communication to the author, under date of May 8, 1944.

described from subsurface middle Tertiary strata of Texas. The age of these beds is in question, and may be Oligocene or Miocene. The range of the genus *Glyptobairdia*, based on these three species, is therefore Oligocene to Recent.

GLYPTOBAIRDIA BERMUDEZI
Stephenson, n. sp.
Plate 42, figures 1–3

Carapace fairly heavy, in side view subrhomboidal. Left valve larger, subequal in length to the right, overlapping it strongly on the dorsal side and slightly on the ventral. Dorsal margin gently arched between weak cardinal angles. Ventral margin slightly concave, more strongly so in the smaller right valve, Anterior end roundly pointed, convex on its ventral half. Posterior end pointed, produced to a short, somewhat upturned beak at midpoint of shell height. A narrow, irregular flange is visible on ventral half of anterior and posterior ends. Surface strongly ornamented, with a narrow, undulating ridge extending from midpoint of anterior end in an irregular course to midpoint of dorsal margin, then curving downward to posterior beak. A short horizontal ridge occupies center of carapace. A third similar ridge on lower part of shell wall is gently arcuate toward ventral margin, and is visible on central half of shell length. Shell wall dorsal and ventral to the ridges is somewhat excavated. Entire surface, exclusive of crests of ridges, is covered with closely spaced small pits. Interior deep, fairly smooth. Hinge in the right valve shows strong, elongate, undivided teeth at the cardinal angles, which are truncated to a slender bar between them so low at its midpoint as to be scarcely visible. A well incised trench, showing exceedingly minute crenulations under favorable lighting, is present just dorsal to the bar, above which is the narrow rim of the dorsal margin, prominent at its midpoint and becoming obscure toward the cardinal angles. Hinge in the left valve consists of terminal sockets, recessed into the dorsal margin which overhangs and partially obscures them. A slender bar between the sockets is most prominent at its midpoint, slopes gently into the socket depressions, and carries very delicate, almost invisible crenulations. A depressed area separates the bar from the dorsal margin. The bar between the teeth of the right valve fits just below and inside the bar of the left valve. The trench of the right valve articulates with the bar of the opposite valve. The raised dorsal margin of the right valve fits into the depressed area just below the dorsal margin of the left valve. Right valve somewhat encased by overhanging margin of left on dorsal half of carapace. Marginal areas moderately broad, steeply shelving inward on the anterior, more nearly flat on the posterior. Radial pore canals numerous, straight, simple, visible on anterior, posterior, and ventral areas. Line of concrescence near and subparallel to outer margin. The peripheral union of the two valves on ventral half of carapace is marked by a sharp break, on the outside of which the shell margin is depressed. A ventral flange near center of left valve, with a slight lip inside it, is fitted to receive the smaller right valve. Muscle scar area slightly anterior and ventral to center of carapace, consisting of a subcircular rosette of about eight small, ovoid scars.

Length (complete specimen) 0.74 mm., height 0.42 mm., width 0.32 mm. Length (right valve) 0.76 mm., height 0.37 mm. Length (left valve) 0.76 mm., height 0.44 mm.

Type locality.—La Chorrera, Habana, Cuba, near mouth of Almendares River, at depth of 2 to 5 fathoms. (Pedro J. Bermudez Station Recent no. 1.)

In addition to the type locality, *G. bermudezi* occurs in the Recent, in harbor dredgings from depth of about 6 fathoms from the Port of San Juan, Puerto Rico, in material collected by F. M. Setzer.

Types.—Holotype no. 3318, a complete specimen. Paratypes nos. 3319, 3320, consisting of the separated right and left valves of a single complete specimen.

GLYPTOBAIRDIA CRUMENA (Stephenson)

Bairdia? crumena Stephenson, 1944, Jour. Paleontology, vol. 18, p. 156, pl. 28, fig. 5.

This species, questionably referred by me to the genus *Bairdia*, is here assigned to the new genus *Glyptobairdia*. It differs from *G. bermudezi* most noticeably in the position of the ridges. The lower ridge is also thickened at its center, and the central ridge is absent.

G. crumena was described from subsurface middle Tertiary beds of Texas.

GLYPTOBAIRDIA HOWEI Stephenson, n. sp.
Plate 42, figures 5, 6; Text figures 1, 2

Carapace in side view subquadrate, with left valve larger and much higher than right. Dorsal margin well arched, more strongly so in left valve. Ventral margin indented, curving upward and bearing very short, blunt spines near anterior and posterior ends. Anterior end rather narrowly rounded; posterior end compressed, produced to bluntly pointed beak. Entire surface closely covered with well impressed, ovoid pits of moderate size. On right valve, a pronounced ridge with narrow crest outlines dorsal margin, and another broader ridge arcs downward from anterior end, extending horizontal to posterior beak at about one-third the shell height above ventral margin. Shell wall is excavated below dorsal ridge and recedes abruptly below ventral ridge. On left valve, dorsal ridge is very weak along hinge line, arcing downward onto shell wall at cardinal angles, becoming stronger on anterior and pronounced on posterior. Ventral ridge is visible only on posterior half of shell. Hinge structure is similar to that of genotype, but with terminal teeth in right valve greatly reduced. Left valve is channelled on posterior to receive and partially encase right valve. Marginal zones of moderate width, with line of concrescence near outer margin of shell on anterior and posterior.

Length (right valve) 0.60 mm., height 0.31 mm. Length (left valve) 0.60 mm., height 0.33 mm.

Remarks.—From the standpoint of outline, overlap, and surface sculpturing, this species agrees well with the genotype. There is some variation in the hinge structure, however, as *G. howei* exhibits a very weak development of terminal teeth in the right valve, and rather poorly defined corresponding sockets in the left valve. Doctor Howe suggested[3] the possibility that the strong teeth present on the genotype may have been developed progressively between Oligocene and Recent times.

[3] Personal communication.

Type locality.—The type specimens were collected from the Red Bluff formation of the Oligocene by Henry V. Howe, 250 feet west of the railway station at Hiwannee, Mississippi, at the top of the exposure, 20 feet above the *Balanophyllia* bed. Specimens of *G. howei* are rather rare in my slide from this locality, which carries a rich ostracode fauna. I have a single right valve

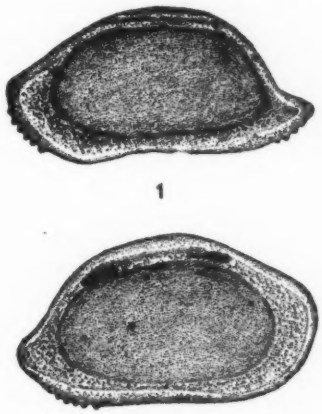

FIG. *1, 2—Glyptobairdia howei* Stephenson, n. sp. *1*, Interior of right valve, syntype no. 3321. *2*, Interior of left valve, syntype no. 3322. ×70. Red Bluff Oligocene, Hiwannee, Mississippi.

in a molt stage, which is smaller than the adult, showing a fine, less pronounced pitting, and the ridges characterizing mature specimens are almost entirely wanting. Doctor Howe kindly forwarded a single specimen taken from 10 feet above the *Balanophyllia* bed at the same exposure. These are the only occurrences of the new species known to me.

Types.—Syntypes, no. 3321 (right valve), no. 3322 (left valve).

REFERENCES

CORYELL, H. N., SAMPLE, C. H., and JENNINGS, P. H., 1935, *Bairdoppilata*, a new genus of Ostracoda, with two new species: Amer. Mus. Novitates, no. 777.

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JOURNAL OF PALEONTOLOGY, VOL. 20, NO. 4, PP. 348–361, PLS. 46–51, 2 TEXT FIGS., JULY 1946

FORAMINIFERA OF THE COOS BAY LOWER TERTIARY, COOS COUNTY, OREGON

MILDRED RIECHERS DETLING
University of Oregon, Eugene, Oregon

ABSTRACT—Foraminifera from the lower Tertiary of Coos Bay, Coos County, Oregon, are described and figured. Forty-seven species and subspecies were obtained from 49 samples. Three species are new. Two formations are discussed. The Coaledo, equivalent to the uppermost part of the Arago formation, is Eocene, and the Bastendorf may be Eocene or Oligocene. The beds are correlated in part with the Cowlitz of Washington and the Tejon and Tumey formations of California. An ecological analysis of the association suggests deposition in a shallow temperate sea. A marked change in the faunal complexion which coincides with a coal seam indicates a time-interval in which evolutionary changes took place.

INTRODUCTION

A THICKNESS of approximately 1.7 miles of Eocene beds are exposed in five miles of wave-cut bluffs three miles south and southeast of Coos Bay, Coos County, Oregon. The coastline extends east-west, and outcrops of the beds, which dip to the east at angles of from 64° to 80°, appear between Cape Arago Lighthouse at the west and Tunnel Point at the east.

Diller (1899) called the coal-bearing part of this section the Coaledo formation, a subdivision of the Arago. Schenck (1927) used the term Bastendorf for the shales that overlie the Coaledo and underlie the Tunnel Point sandstone. Allen and Baldwin (1944) measured these beds and found the Coaledo to be 6015 feet thick and the Bastendorf to be 2905 feet (fig. 1). Turner (1938) subdivided the Coaledo into three parts. Only the upper and lower divisions, predominantly sandstone with small amounts of thin-bedded shale, have yielded numerous molluscan remains. The middle portion, fine soft sandstones and shales, and the Bastendorf, with the same composition, contain most of the microfossils.

LITHOLOGY

The shales in the Coaledo and the Bastendorf are steel-grey to blue-black in color, thinly laminated, and contain varying amounts of sand. Both the fine sandstones and the shales are carbonaceous, and in the Upper Coaledo at Yokam Point, there occurs a seam of lignite.

COLLECTING STATIONS

Collections from the outcrops of the Coaledo-Bastendorf revealed that the foraminifera usually occur in the shales and seldom in sandstone. Of the 49 stations, all but five are in shale; these five are in fine carbonaceous sandstone. The samples were taken at approximately ten-foot intervals. The lower third of the Bastendorf is obscured by alluvium and beach sands.

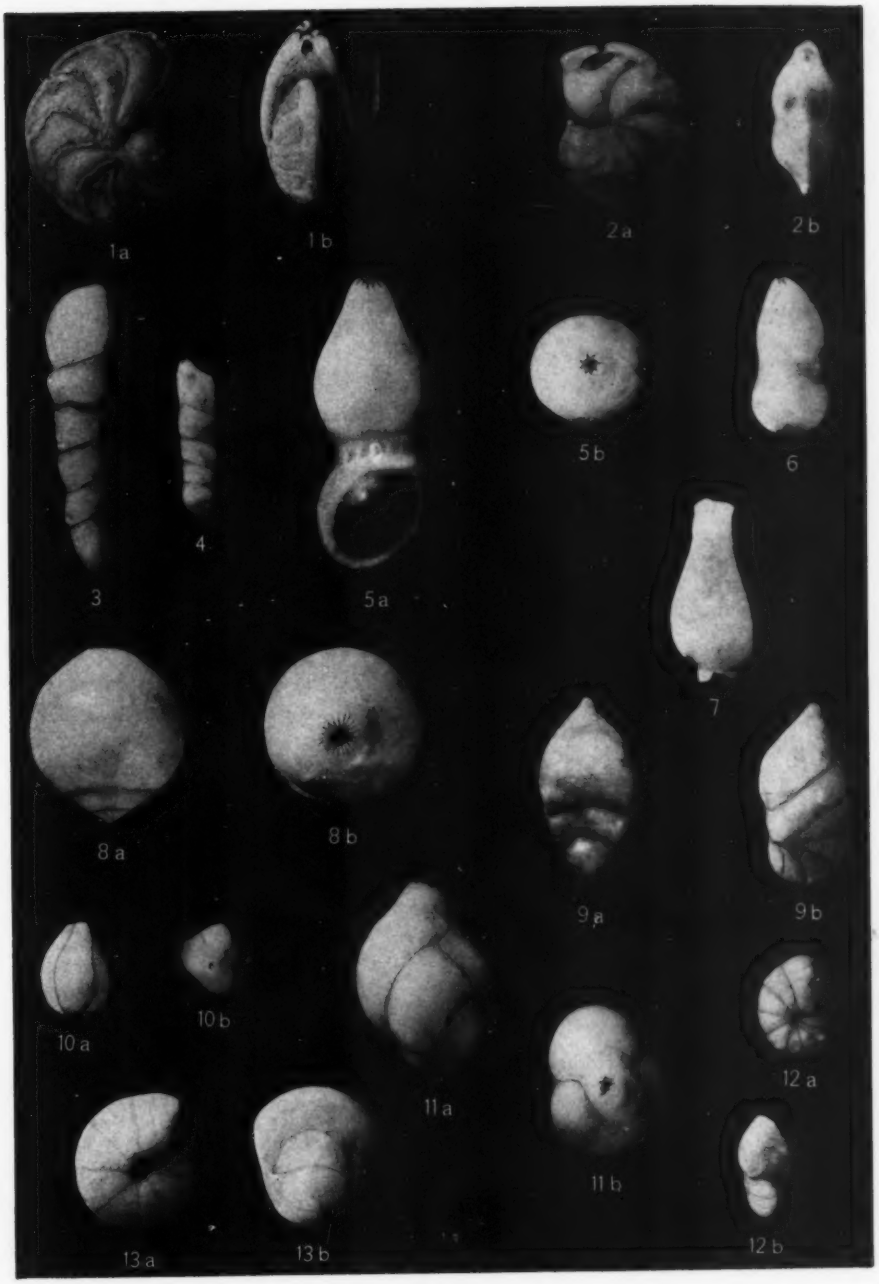
ENVIRONMENT OF DEPOSITION

The fossils of the Coaledo and Bastendorf

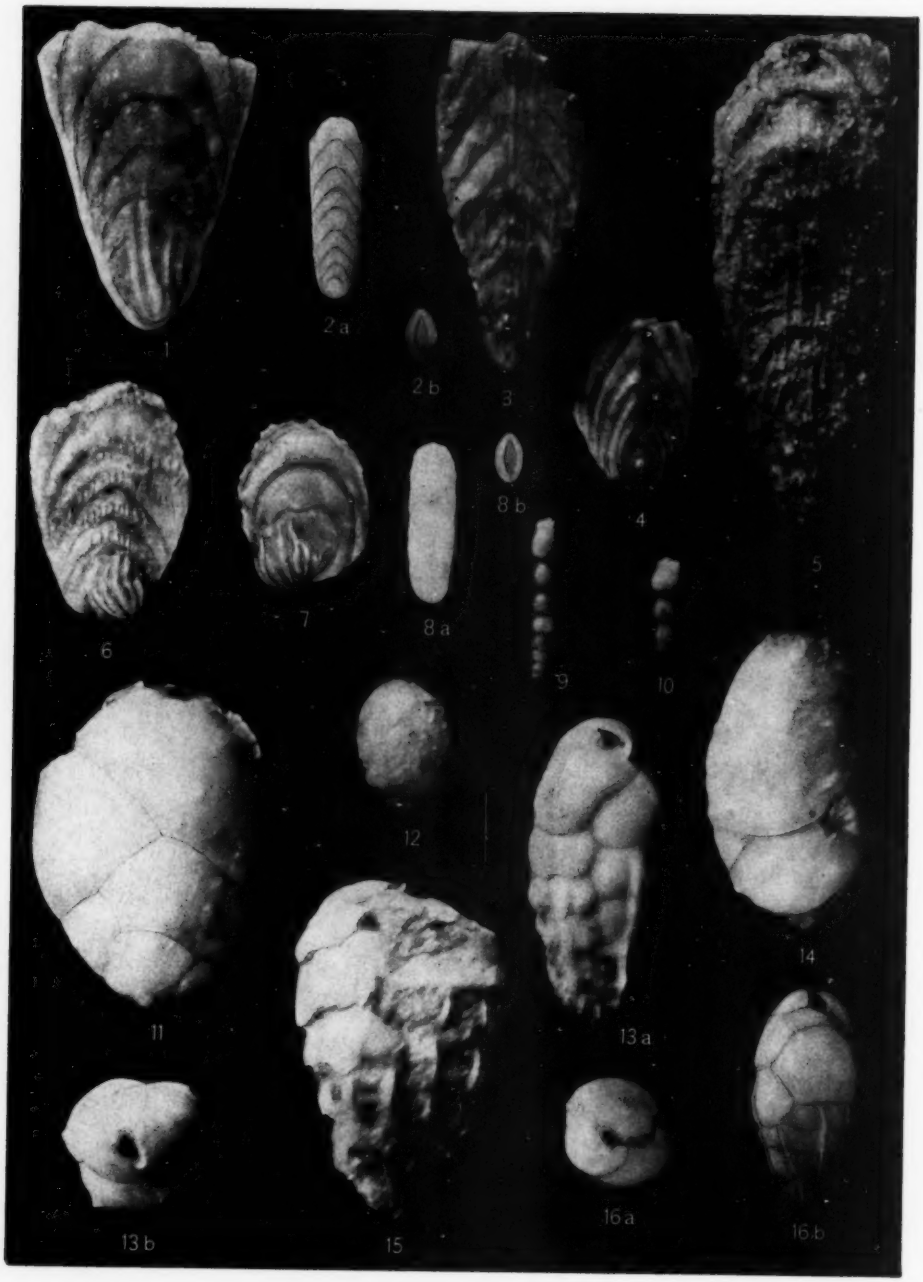
EXPLANATION OF PLATE 46

All figures ×40

FIGS. *1*—*Cyclammina pacifica* Beck. *a*, Side view. *b*, Apertural view. (p. 352)
2—*Cyclammina* sp. *a*, Side view. *b*, Apertural view. (p. 352)
3—*Spiroloculina wilcoxensis* Cushman and Garrett. (p. 352)
4—*Quinqueloculina minuta* Beck. *a*, Side view (three chambers). *b*, Side view (four chambers). *c*, Apertural view. (p. 352)
5—*Quinqueloculina* sp. *a*, Side view (four chambers). *b*, Side view (three chambers). *c*, Apertural view. (p. 352)
6—*Triloculina gilboei* Beck. *a*, Side view (three chambers). *b*, Apertural view. *c*, Side view (two chambers). (p. 352)



Detling – Lower Tertiary Foraminifera



Detling – Lower Tertiary Foraminifera

formations are marine. The high carbon content suggests shallow water deposition. Schenck (1928) reported that the mechanical analysis of a Bastendorf shale sample showed a strong resemblance to silt deposited in a harbor. Turner (1938), in describing the seam of lignite in the upper Coaledo, suggested shoreline conditions on the basis of marine fossils a few feet above and below the lignite. The Cowlitz formation of Washington, correlated by Turner with the Coaledo, demonstrates this oscillation in beds in Olequa Creek, where it is overlain by coal in estuarine deposits (Beck, 1943).

The 47 species of foraminifera described are, according to Cushman's classification (1933), distributed among twelve families. The ecological conditions suggested by these families (Galloway, 1933) vary thus: eight families, warm or temperate shallow water; four families, all depths and all temperatures. Thirty-four species are included in the former group, and thirteen in the latter. If the environment in which this fauna lived was one of shallow water, those representatives of the four families found at all depths and temperatures are no doubt also shallow-water types.

My collections of recent foraminifera from the Coos Bay area, which has a temperate climate, in the littoral zone and down to sixty fathoms, show a certain resemblance to the Tertiary fauna. *Uvigerina* is the most common genus at sub-littoral depths, and *Discorbis ornatissima* is one of the most abundant species in the littoral zone. Species of *Robulus* are common in all collections. The first- and last-named are the most abundant in the fossil collections, both in number of species and individuals.

CORRELATION AND AGE

Turner (1938) used mollusks in correlating the Coaledo with the Cowlitz and the Tejon formations of California, and assigned it to the Eocene. Beck (1943) correlated the Cowlitz with the upper 900 feet of the Tejon, and with 360 feet of shale in the Coaledo formation, on the basis of Foraminifera. He recorded eighteen species common to both the Coaledo and the Cowlitz. I list nine additional Cowlitz species which occur in the Coaledo and Bastendorf formations.

The Tumey formation of California contains, out of 52 species of Foraminifera, thirteen which occur in the Coaledo-Bastendorf beds. Cushman and Simonson (1944) assigned the Bastendorf to the Oligocene on the basis of mollusks.

Because of such conflicting evidence, it seems inadvisable to assign the Bastendorf definitely to either Eocene or Oligocene.

A survey of the distribution of the Coaledo-Bastendorf species reveals that the section may be divided into two parts (fig. 2). Below the coal horizon, between stations 28 and 29 (fig. 1), in the Upper Coaledo, there are eight species which occur in the Lower and Middle Coaledo only. Sixteen species occur only above the coal seam, in the Upper Coaledo and in the Bastendorf. Twenty-three species appear both above and below this dividing line. Assuming the coal to have been deposited in fresh water, two possible explanations for the change in composition of the fauna present themselves. The first is that environmental conditions which prevailed after the fresh-water interval were different from earlier conditions. This idea is untenable because 23, or half, of the species persisted in the adjacent sea through the fresh-water period.

The second possibility is that during the fresh-water period enough time elapsed for considerable evolutionary change to take place, giving rise to new species capable of adapting themselves to the conditions in this area.

If a division were to be made on the basis

EXPLANATION OF PLATE 47

All figures ×40

FIGS. *1, 2, 3—Trochammina?* sp. Three specimens. *1a, b,* Side views of large limonite specimen. *2a, b,* Side views of specimen whose sutures are unusually marked. *3a, c,* Side views of typical specimen. *1c, 2c, 3b,* Peripheral views. (p. 353)

4, 5—Robulus inornatus (d'Orbigny). Two specimens. *4a,* Side view of typical specimen. *5a,* Side view of unusually large specimen. *b,* Apertural views. (p. 353)

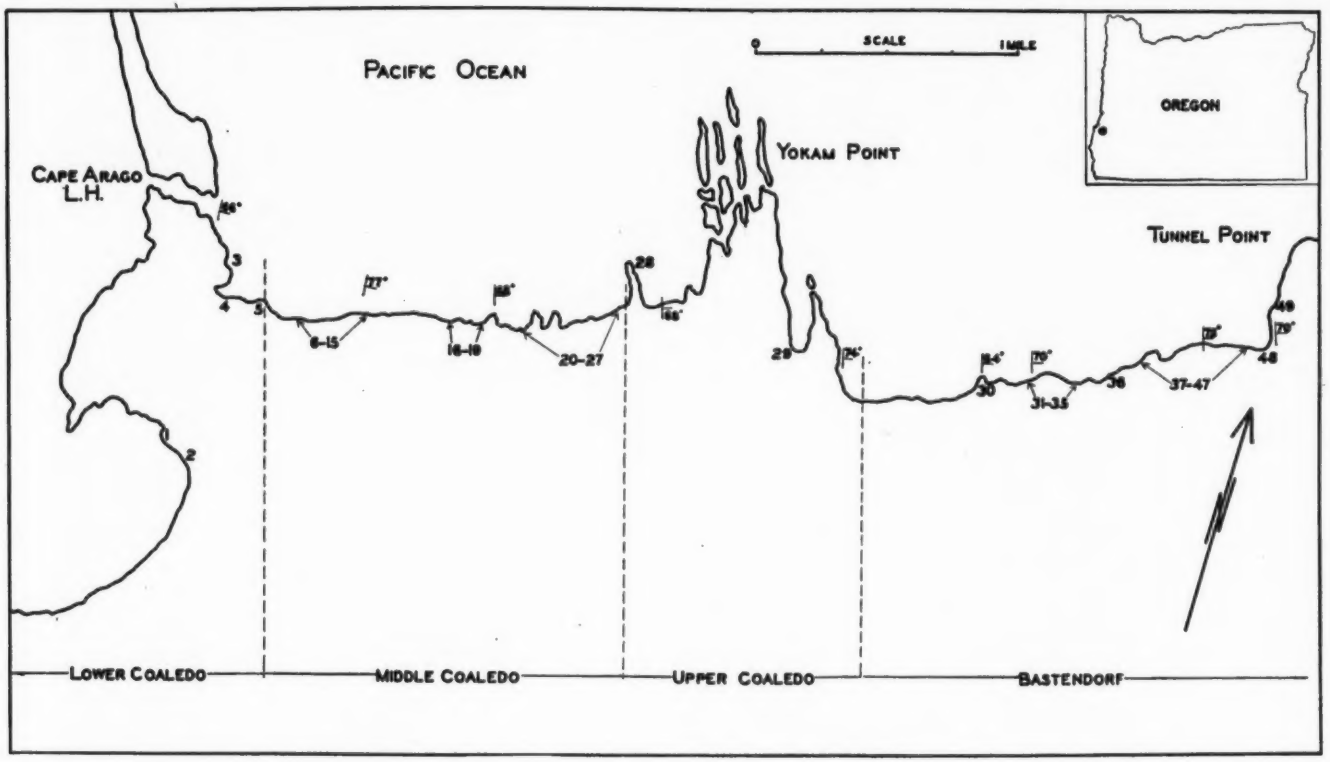


FIG. 1—Coaledo and Bastendorf formations. Adapted from Schenck (1928) and Allen and Baldwin (1944). Collecting stations are indicated by numbers.

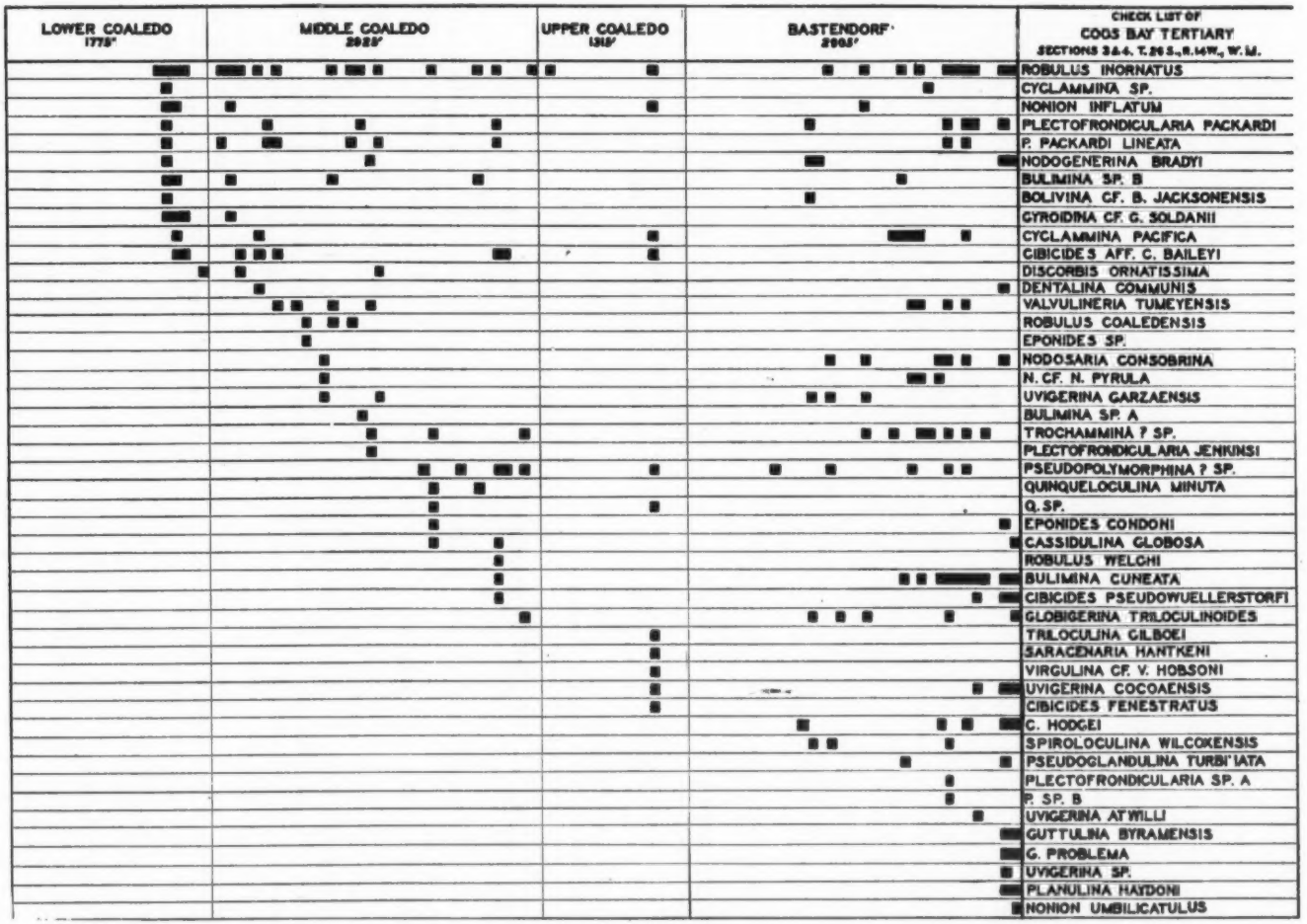

LOWER COALEDO
1775'
MIDDLE COALEDO
2925'
UPPER COALEDO
1315'
BASTENDORF
2905'
CHECK LIST OF
COOS BAY TERTIARY
SECTIONS 3&4, T. 29 S., R. 14W., W. M.
ROBULUS INORNATUS
CYCLAMMINA SP.
NONION INFLATUM
PLECTOFRONDICULARIA PACKARDI
P. PACKARDI LINEATA
NODOGENERINA BRADYI
BULIMINA SP. B
BOLIVINA CF. B. JACKSONENSIS
GYROIDINA CF. G. SOLDANII
CYCLAMMINA PACIFICA
CIBICIDES AFF. C. BAILEYI
DISCORBIS ORNATISSIMA
DENTALINA COMMUNIS
VALVULINERIA TUMEYENSIS
ROBULUS COALEDENSIS
EPONIDES SP.
NODOSARIA CONSOBRINA
N. CF. N. PYRULA
UVIGERINA GARZAENSIS
BULIMINA SP. A
TROCHAMMINA ? SP.
PLECTOFRONDICULARIA JENKINSI
PSEUDOPOLYMORPHINA ? SP.
QUINQUELOCULINA MINUTA
Q. SP.
EPONIDES CONDONI
CASSIDULINA GLOBOSA
ROBULUS WELCHI
BULIMINA CUNEATA
CIBICIDES PSEUDOWUELLERSTORFI
GLOBIGERINA TRILOCULINOIDES
TRILOCULINA GILBOEI
SARACENARIA HANTKENI
VIRGULINA CF. V. HOBSONI
UVIGERINA COCOAENSIS
CIBICIDES FENESTRATUS
C. HODGEI
SPIROLOCULINA WILCOXENSIS
PSEUDOGLANDULINA TURBILIATA
PLECTOFRONDICULARIA SP. A
P. SP. B
UVIGERINA ATWILLI
GUTTULINA BYRAMENSIS
G. PROBLEMA
UVIGERINA SP.
PLANULINA HAYDONI
NONION UMBILICATULUS

FIG. 2.

of time, the coal seam in the Upper Coaledo appears to be the logical place to make it, but too much significance should not be attached to this hypothesis until further investigations have been made.

ACKNOWLEDGMENTS

This investigation was started under the Condon Fellowship in Paleontology at the University of Oregon. The writer is indebted to Dr. Warren D. Smith of the Department of Geology and Geography at the University of Oregon for encouragement and advice, and to the Oregon State Department of Geology and Mineral Industries for valuable material and assistance. Gratitude is expressed to Dr. E. D. Furrer for assistance in photographing the specimens.

TYPES

Holotypes and figured specimens have been deposited in the Museum of Natural History of the University of Oregon.

SYSTEMATIC DESCRIPTIONS

Family LITUOLIDAE

Genus CYCLAMMINA G. B. Brady, 1876

CYCLAMMINA PACIFICA Beck

Plate 46, figure 1

Cyclammina pacifica Beck, 1943, Jour. Paleontology, vol. 17, p. 591, pl. 98, figs. 2, 3.

Dimensions.—Diameter, 1.23 mm.; thickness, .55 mm.

Hypotype.—No. F-1, Museum of Natural History, Univ. of Oregon, from station 29.

Remarks.—There is some variation in size and general outline of individuals of this species. The species occurs in both the Coaledo and Bastendorf formations, at stations 3, 9, 29, 37–40, 45.

CYCLAMMINA sp.

Plate 46, figure 2

Dimensions.—Diameter, .66 mm.; thickness, .20 mm.

Figured specimen.—No. F-2, Museum of Natural History, Univ. of Oregon, from station 41.

Remarks.—Specimens occur in two widely separated stations, in the Lower Coaledo and Bastendorf formations, at stations 2 and 41.

Family MILIOLIDAE

Genus QUINQUELOCULINA d'Orbigny, 1826

QUINQUELOCULINA MINUTA Beck

Plate 46, figure 4

Quinqueloculina minuta Beck, 1943, Jour. Paleontology, vol. 17, p. 593, pl. 99, figs. 5–7.

Dimensions.—Length, .51 mm.; breadth, .31 mm.; thickness, .23 mm.

Hypotype.—No. F-3, Museum of Natural History, Univ. of Oregon, from station 23.

Remarks.—Specimens are few and usually somewhat eroded. They occur at stations 21 and 23.

QUINQUELOCULINA sp.

Plate 46, figure 5

Dimensions.—Length, .66 mm.; breadth, .51 mm.; thickness, .26 mm.

Figured specimen.—No. F-4, Museum of Natural History, Univ. of Oregon, from station 29.

Remarks.—The specimens occur at stations 21 and 29. They are few and in poor condition. The bifid tooth appears to be flush with the surface of the test.

Genus SPIROLOCULINA d'Orbigny, 1826

SPIROLOCULINA WILCOXENSIS Cushman and Garrett

Plate 46, figure 3

Spiroloculina wilcoxensis Cushman and Garrett, 1939, Cushman Lab. Foram. Research Contr., vol. 15, pt. 4, p. 78, pl. 13, figs. 5, 6.

Dimensions.—Length, .50 mm.; breadth, .45 mm.

Hypotype.—No. F-5, Museum of Natural History, Univ. of Oregon, from station 32.

Remarks.—This species is abundant in the Kreyenhagen formation of California and in the transition zone above it (Cushman and Simonson, 1944). It appears here in the Bastendorf formation, at stations 32, 34, 43.

Genus TRILOCULINA d'Orbigny, 1826

TRILOCULINA GILBOEI Beck

Plate 46, figure 6

Triloculina gilboei Beck, 1943, Jour. Paleontology, vol. 17, p. 594, pl. 101, figs. 1–3.

Dimensions.—Length, .95 mm.; breadth, .95 mm.; thickness, .59 mm.

Hypotype.—No. F-6, Museum of Natural History, Univ. of Oregon, from station 29.

Remarks.—This species occurs at station 29. The surface is irregularly pitted and has a varnished appearance.

Family TROCHAMMINIDAE
Genus TROCHAMMINA Parker and Jones, 1859
TROCHAMMINA ? sp.
Plate 47, figures 1, 2, 3

Dimensions.—Length, .69–.90 mm.; breadth, .55–.84 mm.; thickness, .21–.26 mm.

Figured specimens.—No. F-7, Museum of Natural History, Univ. of Oregon; figure 1 from station 37, figures 2 and 3 from station 21.

Remarks.—This species is common in Middle and Upper Coaledo and Bastendorf beds, occurring at stations 18, 21, 26, 36, 37, 40, 41, 43, 45, 47. Individuals vary widely in size, proportion, and manner in which chambers are added. Some specimens suggest an eventual uncoiling. The aperture, when visible, is a short narrow slit near the periphery on the ventral side. The wall is arenaceous. There is no calcite present.

Family LAGENIDAE
Genus ROBULUS Montfort, 1808
ROBULUS COALEDENSIS Detling, n. sp.
Plate 48, figure 1

Test medium-size, thickest at umbonal region; closely coiled; periphery subacute, slightly lobulate; chambers 10–11, similarly shaped, increasing slightly in size as added; sutures markedly limbate, deeply curved; wall smooth, finely perforate; apertural face flat; aperture typically robuline. Length, .69 mm.; breadth, .56 mm.; thickness, .31 mm.

Holotype.—No. F-8, Museum of Natural History, Univ. of Oregon, from station 16.

Remarks.—This species appears in the Middle Coaledo only, at stations 13, 15, 16.

ROBULUS INORNATUS (d'Orbigny)
Plate 47, figures 4, 5

Robulina inornata d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 102, pl. 4, figs. 25, 26.

Dimensions.—Length, .80–1.36 mm.; breadth, .69–1.15 mm.; thickness, .40–.60 mm.

Hypotype.—No. F-9, Museum of Natural History, Univ. of Oregon, from station 29 (fig. 4).

Remarks.—This species is the most abundant, and represented most frequently, in the entire collection. It occurs at stations 1–4, 6–9, 11, 15–17, 19, 21, 23, 24, 27–29, 34, 36, 38, 40, 43–46, 48, 49. There is wide variation in size and number of visible chambers.

ROBULUS WELCHI Church
Plate 48, figure 2

Robulus welchi Church, 1931, California Dept. Nat. Resources, Div. Mines Rept., vol. 27, no. 2, p. 212, pl. C, figs. 13, 14.

Dimensions.—Length, .55 mm.; breadth, .45 mm.; thickness, .23 mm.

Hypotype.—No. F-10, Museum of Natural History, Univ. of Oregon, from station 24.

Remarks.—A single specimen was found in the Middle Coaledo.

Genus DENTALINA d'Orbigny, 1826
DENTALINA COMMUNIS (d'Orbigny)
Plate 48, figures 3, 4

Nodosaria (Dentalina) communis d'Orbigny, 1826, Soc. Annales Sci. Nat., vol. 7, p. 254, no. 35.

Dimensions.—Length, .56–1.00 mm.

Hypotype.—No. F-11, Museum of Natural History, Univ. of Oregon, from station 9 (fig. 3). Figure 4 from station 48.

Remarks.—The two specimens figured illustrate a possible alternation of generations. The larger, many-chambered test with the small proloculum shows the microspheric form, and the smaller, few-chambered test with the large proloculum, the megalospheric form. The species occurs at stations 9 and 48.

Genus NODOSARIA Lamarck, 1812
NODOSARIA CONSOBRINA (d'Orbigny)
Plate 48, figures 5, 6

Dentalina consobrina d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 46, pl. 2, figs. 1–3.
Nodosaria (Dentalina) consobrina Cushman and G. D. Hanna, 1927, Proc. Calif. Acad. Sci., ser. 4, vol. 16, p. 214, pl. 13, figs. 12, 13.

Dimensions.—Length, .55–1.00 mm.; breadth, .26–.39 mm.

Hypotype.—No. F-12, Museum of Nat-

ural History, Univ. of Oregon, from station 48 (fig. 5).

Remarks.—The smaller specimen figured appears to be complete. The other is the apertural end of a much larger individual. The species was found in the Bastendorf formation only, at stations 14, 34, 36, 42, 43, 45, 48.

NODOSARIA cf. N. PYRULA d'Orbigny
Plate 48, figure 7

Nodosaria pyrula d'Orbigny, 1826, Annales Sci. Nat. vol. 7, p. 253, no. 13.

Dimensions.—Length, .63 mm.; diameter, .29 mm.

Hypotype.—No. F-13, Museum of Natural History, Univ. of Oregon, from station 14.

Remarks.—This species is relatively rare, and no individual is unbroken. Specimens occur at stations 14, 39, 40, 42.

Genus PSEUDOGLANDULINA Cushman, 1929
PSEUDOGLANDULINA TURBINATA Detling, n. sp.
Plate 48, figure 8

Test medium in size, nearly spherical; chambers three, uniserial throughout, the last-formed constituting four-fifths of the total length; initial end pointed, forming an angle of 110°; apertural end truncate; sutures moderately distinct, flush with surface; wall smooth, finely perforate; aperture radiate, entosolenian, and centrally located. Length, .61 mm.; breadth, .55 mm.

Holotype.—No. F-14, Museum of Natural History, Univ. of Oregon, from station 48.

Remarks.—This species occurs in both the Coaledo and Bastendorf formations, at stations 38 and 48.

Genus SARACENARIA Defrance, 1824
SARACENARIA HANTKENI (Cushman)
Plate 48, figure 9

Saracenaria arcuata (d'Orbigny) var. *hantkeni* Cushman, 1933, Cushman Lab. Foram. Research Contr., vol. 9, pt. 1, p. 4, pl. 1, figs. 11, 12.

Dimensions.—Length, .64 mm.; breadth, .34 mm.

Hypotype.—No. F-15, Museum of Natural History, Univ. of Oregon, from station 29.

Remarks.—A single specimen, from the Upper Coaledo, is identical with *S. hantkeni* of Beck (1943).

Family POLYMORPHINIDAE
Genus GUTTULINA d'Orbigny, 1839
GUTTULINA BYRAMENSIS (Cushman)
Plate 48, figure 10

Polymorphina byramensis Cushman, 1922, U. S. Geol. Survey Prof. Paper 129, pp. 94, 131, pl. 17, figs. 2a, b.

Dimensions.—Length, .34 mm.; breadth, .25 mm.; thickness, .19 mm.

Hypotype.—No. F-16, Museum of Natural History, Univ. of Oregon, from station 48.

Remarks.—This species appears at the top of the Bastendorf formation, at stations 48 and 49.

GUTTULINA PROBLEMA d'Orbigny
Plate 48, figure 11

Guttulina problema d'Orbigny, 1826, Soc. Annales Sci. Nat., vol. 7, p. 226, no. 14.

Dimensions.—Length, .70 mm.; breadth, .50 mm.; thickness, .43 mm.

Hypotype.—No. F-17, Museum of Natural History, Univ. of Oregon, from station 48.

Remarks.—This species occurs at the top of the Bastendorf formation, at stations 48 and 49.

Genus PSEUDOPOLYMORPHINA Cushman and Ozawa, 1928
PSEUDOPOLYMORPHINA? sp.
Plate 49, figures 11, 12, 14

Dimensions.—Length, .37–1.1 mm.; breadth, .34–.88 mm.

Figured specimens.—No. F-18, Museum of Natural History, Univ. of Oregon; figures 11 and 14 from station 43, figure 12 from station 30.

Remarks.—This species is common in both the Coaledo and Bastendorf formations, at stations 20, 22, 24–26, 29, 30, 34, 39, 43, 45. All specimens are so crushed that no apertures are discernible. There is a wide variation in size. The calcite walls are finely perforate.

Family NONIONIDAE
Genus NONION Montfort, 1808
NONION INFLATUM (Cushman and Ellisor)
Plate 48, figure 12

Nonion scaphum (Fichtel and Moll) var. *inflatum* Cushman and Ellisor, 1932, Cushman Lab. Foram. Research Contr., vol. 8, pt. 2, p. 41, pl. 6, figs. 2a, b.

Dimensions.—Length, .35 mm.; breadth, .24 mm.; thickness, .19 mm.

Hypotype.—No. F-19, Museum of Natural History, Univ. of Oregon, from station 2.

Remarks.—This species is like *N. inflatum* of Beck. It occurs occasionally in both the Coaledo and Bastendorf formations, at stations 2, 3, 7, 29, 36. Most of the specimens are crushed.

NONION UMBILICATULUS (Montagu)
Plate 48, figure 13

Nautilus umbilicatulus Montagu, Testacea Britannica, 1803, p. 191; Suppl., 1808, p. 78, pl. 18, fig. 1.

Dimensions.—Length, .50 mm.; breadth, .44 mm.; thickness, .42 mm.

Hypotype.—No. F-20, Museum of Natural History, Univ. of Oregon, from station 49.

Remarks.—This species occurs in the top of the Bastendorf formation, at station 49.

Family HETEROHELICIDAE
Genus PLECTOFRONDICULARIA Liebus, 1903
PLECTOFRONDICULARIA JENKINSI Church
Plate 49, figures 2, 8

Plectofrondicularia jenkinsi Church, 1931, Calif. Dept. Nat. Resources, Div. Mines Rept., vol. 27, no. 2, p. 208, pl. A, figs. 4, 5, 7–9.

Dimensions.—Length, .56–.62 mm.; breadth, .19 mm.; thickness, .11 mm.

Hypotype.—No. F-21, Museum of Natural History, Univ. of Oregon, from station 18 (fig. 2).

Remarks.—This species occurs at one station, in the Middle Coaledo, where it is very numerous.

PLECTOFRONDICULARIA PACKARDI
Cushman and Schenck
Plate 49, figure 1

Plectofrondicularia packardi Cushman and Schenck, 1928, Univ. California Publ., Bull. Dept. Geol. Sci., vol. 17, no. 9, p. 311, pl. 43, figs. 14, 15.

Dimensions.—Length, 1.1 mm.; breadth, .76 mm.

Hypotype.—No. F-22, Museum of Natural History, Univ. of Oregon, from Station 43.

Remarks.—This is a common species, widely distributed, occurring at stations 2, 10, 17, 24, 32, 43, 45, 46, 48.

PLECTOFRONDICULARIA PACKARDI MULTILINEATA Cushman and Simonson
Plate 49, figures 3, 5

Plectofrondicularia packardi Cushman and Schenck var. *multilineata* Cushman and Simonson, 1944, Jour. Paleontology, vol. 18, p. 197, pl. 32, figs. 2–4.

Dimensions.—Length, 1.20–1.75 mm.; breadth, .52–.66 mm.

Hypotype.—No. F-23, Museum of Natural History, Univ. of Oregon, from station 2 (fig. 5). Figure 3 from station 43.

Remarks.—This species is widely distributed, occurring at stations 2, 6, 10, 11, 16, 19, 24, 43, 45. It is readily distinguished by its characteristic outline and more or less persistent striae.

PLECTOFRONDICULARIA sp. A
Plate 49, figures 6, 7

Dimensions.—Length, .60 mm.; breadth, .45–.56 mm.

Figured specimens.—No. F-24, Museum of Natural History, Univ. of Oregon, from station 43.

Remarks.—The two specimens figured show the deeply curved sutures and the rounded outline of the test. The initial chambers are much inflated and the wall deeply grooved. In the larger specimen the grooves continue up onto the newer chambers. The pronounced asymmetry of the initial end is a prominent feature. More specimens are necessary before specific determination can be made. Specimens occur at station 43.

PLECTOFRONDICULARIA sp. B
Plate 49, figure 4

Dimensions.—Length, .62 mm.; breadth, .42 mm.

Figured specimen.—No. F-25, Museum of Natural History, Univ. of Oregon, from station 43.

Remarks.—This single specimen shows an acute angle in the apical portions of the chambers. The proloculum appears as a tiny knob surrounded by the first two or three visible chambers. The test is very thin.

Genus NODOGENERINA Cushman, 1927
NODOGENERINA BRADYI Cushman
Plate 49, figures 9, 10

Nodogenerina bradyi Cushman, 1927, Cushman Lab. Foram. Research Contr., vol. 2, pt. 4, p. 79. (Figured by Brady, 1884, Rep. Voy. *Challenger*, Zoology, vol. 9, pl. 76, fig. 8.)

Dimensions.—Length, .36–.61 mm.; breadth, .12 mm.

Hypotype.—No. F-26, Museum of Natural History, Univ. of Oregon, from station 2 (fig. 9).

Remarks.—The specimens figured show the two typical forms. Figure 9 is the microspheric, and figure 10, the megalospheric phase. The species is widely distributed, occurring at stations 2, 18, 32, 33, 48, 49.

Family BULIMINIDAE
Genus BULIMINA d'Orbigny, 1826
BULIMINA CUNEATA (Cushman)
Plate 49, figures 13, 15, 16

Bulimina jacksonensis Cushman var. *cuneata* Cushman, 1926, Cushman Lab. Foram. Research Contr., vol. 2, pt. 2, p. 35 (Figured by Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, pl. 13, figs. 10, 11); Beck, 1943, Jour. Paleontology, vol. 17, p. 605, figs. 3, 9.

Dimensions.—Length, .76–1.2 mm.; breadth, .41–.73 mm.

Hypotype.—No. F-27, Museum of Natural History, Univ. of Oregon, from station 43 (fig. 16). Figure 13 from station 43, figure 15 from station 17.

Remarks.—This is one of the commonest species. It is widely distributed and relatively numerous, occurring at stations 17, 24, 38, 40, 42–48. There is considerable variation in size.

BULIMINA sp. A
Plate 50, figure 1

Dimensions.—Length, .63 mm.; breadth, .36 mm.

Figured specimen.—No. F-28, Museum of Natural History, Univ. of Oregon, from station 17.

Remarks.—This single well preserved specimen has a smooth wall and clearly defined sutures and aperture.

BULIMINA sp. B
Plate 50, figure 2

Dimensions.—Length, .49 mm.; breadth, .35 mm.

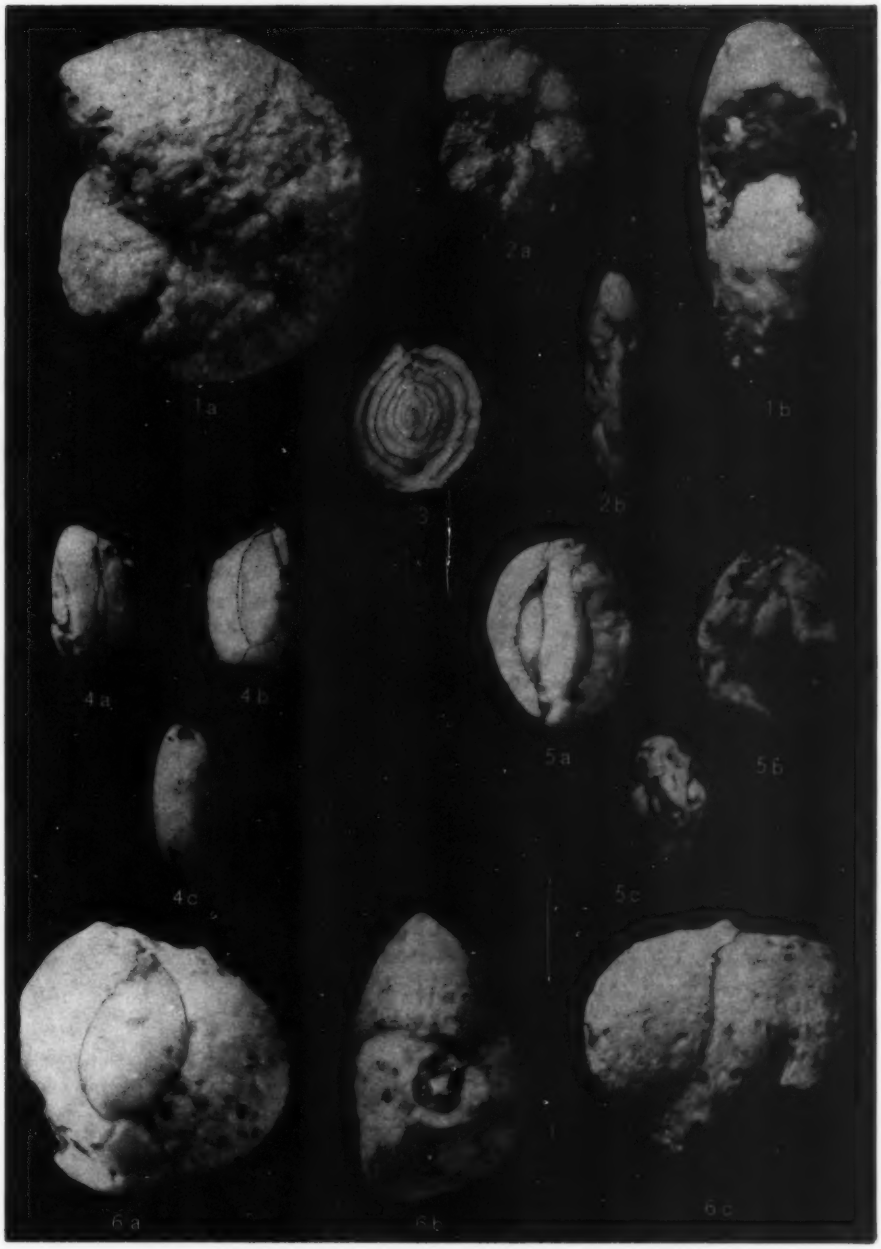
Figured specimen.—No. F-29, Museum of Natural History, Univ. of Oregon, from station 23.

Remarks.—This species appears in widely separated strata, at stations 2, 3, 7, 15, 23, 38, usually in small numbers. The wall is finely perforate and matte in texture. The aperture is depressed. More and better preserved specimens are necessary for specific determination.

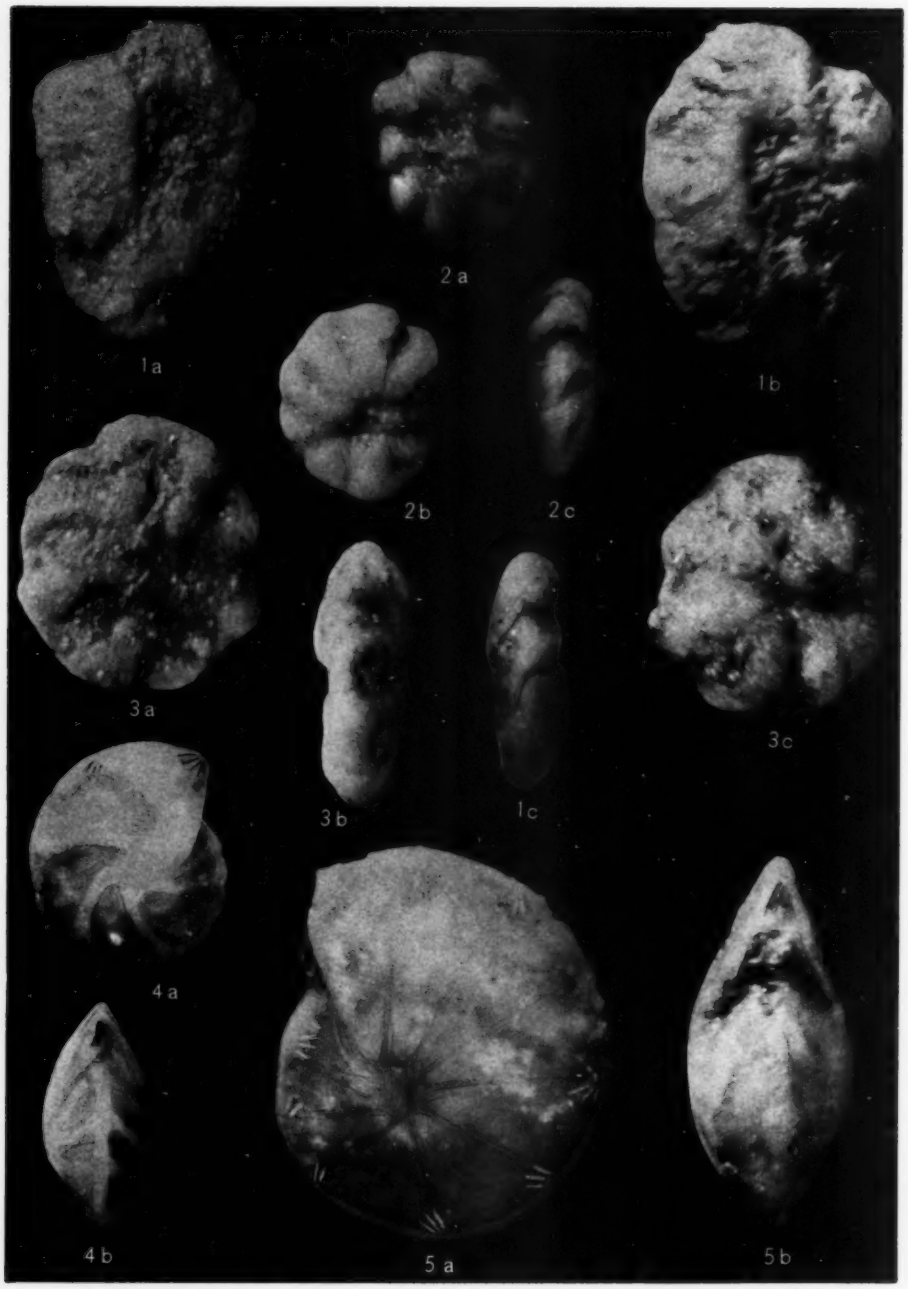
EXPLANATION OF PLATE 48

All figures ×40

FIGS. *1—Robulus coaledensis* Detling n. sp. *a*, Side view. *b*, Apertural view. Holotype. (p. 353)
2—Robulus welchi Church. *a*, Side view. *b*, Apertural view. (p. 353)
3, 4—Dentalina communis (d'Orbigny). (p. 353)
5, 6—Nodosaria consobrina (d'Orbigny). Two specimens. *5a*, Side view of apertural end of large incomplete specimen. *b*, Apertural view. *6*, Side view of small complete specimen. (p. 353)
7—Nodosaria cf. *N. pyrula* d'Orbigny. Side view of apertural end of incomplete specimen. (p. 354)
8—Pseudoglandulina turbinata Detling n. sp. *a*, Side view. *b*, Apertural view. Holotype. (p. 354)
9—Saracenaria hantkeni (Cushman). *a*. Apertural view. *b*, Side view. (p. 354)
10—Guttulina byramensis (Cushman). *a*, Side view. *b*, Apertural view. (p. 354)
11—Guttulina problema d'Orbigny. *a*, Side view. *b*, Apertural view. (p. 354)
12—Nonion inflatum (Cushman and Ellisor). *a*, Side view. *b*, Apertural view. (p. 355)
13—Nonion umbilicatulus (Montagu). *a*, Side view. *b*, Apertural view. (p. 355)



Detling – Lower Tertiary Foraminifera



Detling – Lower Tertiary Foraminifera

Genus VIRGULINA d'Orbigny, 1826
VIRGULINA cf. V. HOBSONI Beck
Plate 50, figure 3

Virgulina hobsoni Beck, 1943, Jour. Palentology, vol. 17, p. 606, pl. 107, figs. 6, 10.

Dimensions.—Length, .39 mm.; breadth, .14 mm.

Hypotype.—No. F-30, Museum of Natural History, Univ. of Oregon, from station 29.

Remarks.—This single well preserved specimen shows the characters of *V. hobsoni.*

Genus BOLIVINA d'Orbigny, 1839
BOLIVINA cf. B. JACKSONENSIS Cushman and Applin
Plate 50, figure 4

Bolivina jacksonensis Cushman and Applin, 1926, Am. Assoc. Petroleum Geologists Bull., vol. 10, pt. 1, no. 2, p. 167, pl. 7, figs. 3, 4.

Dimensions.—Length, .34 mm.; breadth, .19 mm.

Hypotype.—No. F-31, Museum of Natural History, Univ. of Oregon, from station 2.

Remarks.—This species appears in the Lower Coaledo and Bastendorf formations at stations 2 and 32. It bears a very close resemblance to *B. jacksonensis* figured by Cushman and Simonson (1944), who report it characteristic of the upper Eocene and lower Oligocene.

Genus UVIGERINA d'Orbigny, 1826
UVIGERINA ATWILLI Cushman and Simonson
Plate 50, figures 5, 6

Uvigerina atwilli Cushman and Simonson, 1944, Jour. Paleontology, vol. 18, p. 200, pl. 33, figs. 2–4.

Dimensions.—Length, .68–.86 mm.; breadth, .36–.39 mm.

Hypotype.—No. F-32, Museum of Natural History, Univ. of Oregon, from station 46.

Remarks.—This species occurs in the upper part of the Bastendorf formation, at station 46. There is some variation in the prominence and persistence of the striae on the initial portion.

UVIGERINA COCOAENSIS Cushman
Plate 50, figure 7

Uvigerina cocoaensis Cushman, 1925, Cushman Lab. Foram. Research Contr., vol. 1, pt. 3, p. 68, pl. 10, fig. 12.

Dimensions.—Length, .60 mm.; breadth, .35 mm.

Hypotype.—No. F-33, Museum of Natural History, Univ. of Oregon, from station 48.

Remarks.—This species occurs abundantly in the Upper Coaledo and Bastendorf formations, at stations 29, 46, 48, 49.

UVIGERINA GARZAENSIS Cushman and Siegfus
Plate 50, figure 8

Uvigerina garzaensis Cushman and Siegfus, 1939, Cushman Lab. Foram. Research Contr., vol. 15, pt. 2, p. 28, pl. 6, figs. 15a, b.

Dimensions.—Length, .36 mm.; breadth, .22 mm.

Hypotype.—No. F-34, Museum of Natural History, Univ. of Oregon, from station 32.

Remarks.—This is a widely distributed species, although not very common, occurring at stations 14, 19, 32, 34, 36. Most of the specimens are crushed.

EXPLANATION OF PLATE 49
All figures ×40

FIGS. *1—Plectofrondicularia packardi* Cushman and Schenck. Side view. (p. 355)
2, 8—Plectofrondicularia jenkinsi Church. Two specimens. *a*, Side views. *b*, Apertural views. (p. 355)
3, 5—Plectofrondicularia packardi multilineata Cushman and Simonson. Two different specimens. Side views. (p. 355)
4—Plectofrondicularia sp. B. Side view. (p. 356)
6, 7—Plectofrondicularia sp. A. Side views of two specimens. (p. 355)
9, 10—Nodogenerina bradyi Cushman. *9*, Microspheric specimen. *10*, Megalospheric specimen. (p. 356)
11, 12, 14—Pseudopolymorphina ? sp. Side views of three specimens. (p. 354)
13, 15, 16—Bulimina cuneata (Cushman). Three specimens. *13a*, Side view. *13b*, Apertural view. *15*, Side view of unusually large crushed specimen. *16a*, Apertural view. *16b*, Side view. (p. 356)

UVIGERINA sp.
Plate 50, figure 9

Dimensions.—Length, .70 mm.; breadth, .43 mm.

Figured specimen.—No. F-35, Museum of Natural History, Univ. of Oregon, from station 48.

Remarks.—This single specimen, from the top of the Bastendorf formation, has rather striking perforations, large and widely spaced. More specimens are needed before this most interesting species can be determined.

Family ROTALIIDAE
Genus DISCORBIS Lamarck, 1804
DISCORBIS ORNATISSIMA Cushman
Plate 50, figures 10, 14

Discorbis ornatissima Cushman, 1925, Cushman Lab. Foram. Research Contr., vol. 1, no. 2, p. 42, pl. 6, figs. 11, 12.

Dimensions.—Diameter, .56 mm.; height, .24 mm.

Hypotype.—No. 36, Museum of Natural History, Univ. of Oregon, from station 19 (fig. 10). Figure 14 from station 5.

Remarks.—This species occurs occasionally in the Coaledo formation, at stations 5, 8, 19; some individuals are associated in plastogamy. Figure 10 shows an individual which appears to have undergone plastogamy, leaving it with the typically excavated test.

Genus VALVULINERIA Cushman, 1926
VALVULINERIA TUMEYENSIS Cushman and Simonson
Plate 50, figure 11

Valvulineria tumeyensis Cushman and Simonson, 1944, Jour. Paleontology, vol. 18, p. 201, pl. 33, figs. 13, 14.

Dimensions.—Diameter, .56 mm.; height, .33 mm.

Hypotype.—No. F-37, Museum of Natural History, Univ. of Oregon, from station 43.

Remarks.—Some of the specimens are excellently preserved, and show in detail the limbate sutures of the initial whorls. The species appears in the Coaledo and Bastendorf formations, at stations 11, 12, 15, 18, 39, 40, 43, 45.

Genus GYROIDINA d'Orbigny, 1826
GYROIDINA cf. G. SOLDANII d'Orbigny
Plate 50, figure 13

Gyroidina soldanii d'Orbigny, 1826, Soc. Annales Sci. Nat., vol. 7, p. 278.

Dimensions.—Diameter, .34 mm.; height, .23 mm.

Hypotype.—No. F-38, Museum of Natural History, Univ. of Oregon, from station 3.

Remarks.—This species is common in the Lower Coaledo, appearing at stations 2, 3, 4, 7.

Genus EPONIDES Montfort, 1808
EPONIDES CONDONI Cushman and Schenck
Plate 50, figure 12

Eponides condoni Cushman and Schenck, 1928, Univ. California Publ., Bull. Dept. Geol. Sci., vol. 17, no. 9, p. 313, pl. 44, figs. 6, 7a–c.

Dimensions.—Diameter, .25 mm.; height, .16 mm.

Hypotype.—No. F-39, Museum of Natural History, Univ. of Oregon, from station 21.

Remarks.—The species appears in the Upper Coaledo at one station where it is very numerous.

EPONIDES sp.
Plate 50, figure 15

Dimensions.—Diameter, .80 mm.; height, .50 mm.

Figured specimen.—No. F-40, Museum of Natural History, Univ. of Oregon, from station 13.

Remarks.—This is a single large well preserved specimen.

Family CASSIDULINIDAE
Genus CASSIDULINA d'Orbigny, 1826
CASSIDULINA GLOBOSA Hantken
Plate 51, figure 3

Cassidulina globosa Hantken, 1875 (1876), Magy, kir. foldt, int. Evkönyve, vol. 4, p. 54, pl. 16, fig. 2.

Dimensions.—Height, .34 mm.; breadth, .28 mm.

Hypotype.—No. F-41, Museum of Natural History, Univ. of Oregon, from station 49.

Remarks.—This species occurs in two zones in the Middle Coaledo at stations 21 and 24, and in one zone in the Bastendorf

formation, at station 49; there are many individuals.

Family GLOBIGERINIDAE

Genus GLOBIGERINA d'Orbigny, 1826

GLOBIGERINA TRILOCULINOIDES Plummer

Plate 51, figure 2

Globigerina triloculinoides Plummer, 1927, Texas Univ. Bull. 2644, p. 134, pl. 8, figs. 10a, b, c.

Dimensions.—Diameter, .26 mm.

Hypotype.—No. F-42, Museum of Natural History, Univ. of Oregon, from station 32.

Remarks.—There appears to be considerable variation in this species. It occurs in the Middle Coaledo and Bastendorf formations, at stations 26, 32, 35, 36, 43, 49.

Family ANOMALINIDAE

Genus PLANULINA d'Orbigny, 1826

PLANULINA HAYDONI Cushman and Schenck

Plate 51, figure 1

Planulina haydoni Cushman and Schenck, 1928, Univ. California Publ., Bull. Dept. Geol. Sci., vol. 17, no. 9, p. 316, pl. 45, figs. 7a–c.

Dimensions.—Diameter, .77 mm.; height, .29 mm.

Hypotype.—No. F-43, Museum of Natural History, Univ. of Oregon, from station 49.

Remarks.—This species is abundant at the top of the Bastendorf formation, at stations 48 and 49.

Genus CIBICIDES Montfort, 1808

CIBICIDES aff. BAILEYI Beck

Plate 51, figure 7

Cibicides baileyi Beck, 1943, Jour. Paleontology, vol. 17, p. 611, pl. 109, figs. 7–9.

Dimensions.—Diameter, .64 mm.; thickness, .26 mm.

Hypotype.—No. F-44, Museum of Natural History, Univ. of Oregon, from station 9.

Remarks.—The specimens are slightly larger than *C. baileyi* and usually have one fewer spiral sutures, but are otherwise similar. They occur in the Coaledo formation at stations 3, 4, 8, 9, 11, 24, 25, 29.

CIBICIDES FENESTRATUS Detling n. sp.

Plate 51, figures 4, 5

Test medium sized, compressed, biconvex or flattened dorsally; chambers increasing slightly in size throughout; periphery slightly rounded; sutures on ventral side somewhat raised toward inner portion, of clear shell material; umbilicus depressed, with chamber walls sharply depressed between inner ends of the sutures, leaving projections extending into and partly covering the umbilical region; walls coarsely perforate; lip overhanging the aperture, which is a curved slit at base of last chamber, extending across the face of chamber to the umbilicus on ventral side, and a short distance on dorsal side in some specimens. Individuals show both dextral and sinistral coiling. Length, .74 mm.; breadth, .60 mm.; thickness, .20 mm.

Holotype.—No. F-45, Museum of Natural History, Univ. of Oregon, from station 29 (fig. 5).

Remarks.—Numerous individuals occur in the Upper Coaledo at station 29. There is some resemblance to the figure of *Planulina* sp. of Cushman and Simonson (1944).

CIBICIDES HODGEI Cushman and Schenck

Plate 51, figures 6, 8

Cibicides hodgei Cushman and Schenck, 1928, Univ. California Dept. Geol. Sci. Bull., vol. 17, no. 9, p. 315, pl. 45, figs. 3, 5.

Dimensions.—Length, .48–.64 mm.; breadth, .39–.55 mm.; thickness, .24–.30 mm.

Hypotype.—No. F-46, Museum of Natural History, Univ. of Oregon, from station 48 (fig. 8). Figure 6 from station 46.

Remarks.—The two specimens represent two size groups, suggesting an alternation of generations. They also show both dextral and sinistral coiling. The species is confined to the Bastendorf formation, appearing at stations 31, 42, 45, 48, 49.

CIBICIDES PSEUDOWUELLERSTORFI Cole

Plate 51, figures 9, 10

Cibicides pseudowuellerstorfi Cole, 1927, Bulls., Amer. Pal., vol. 14, no. 51, p. 36, pl. 1, figs. 13, 14.

Dimensions.—Length, .44–.73 mm.; breadth, .36–.59 mm.; thickness, .19 mm.

Hypotype.—No. F-47, Museum of Natural History, Univ. of Oregon, from station 48 (fig. 9).

Remarks.—The two specimens figured show the two size groups, suggesting alternation of generations. The smaller is much more common. There is some variation in the convexity of the dorsal side. Specimens occur at stations 24, 46, 48, 49.

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EXPLANATION OF PLATE 50

All figures ×40

FIGS. *1—Bulimina* sp. A. *a*, Side view. *b*, Apertural view. (p. 356)

2—Bulimina sp. B. *a*, Side view. *b*, Apertural view. (p. 356)

3—Virgulina cf. *V. hobsoni* Beck. Side view. (p. 357)

4—Bolivina cf. *B. jacksonensis* Cushman and Applin. *a*, Side view. *b*, Apertural view. (p. 357)

5, 6—Uvigerina atwilli Cushman and Simonson. Two specimens. *a*, Side views. *b*, Apertural views. (p. 357)

7—Uvigerina cocoaensis Cushman. *a*, Side view. *b*, Apertural view. (p. 357)

8—Uvigerina garzaensis Cushman and Siegfus. *a*, Side view. *b*, Apertural view. (p. 357)

9—Uvigerina sp. *a*, Side view. *b*, Apertural view. (p. 358)

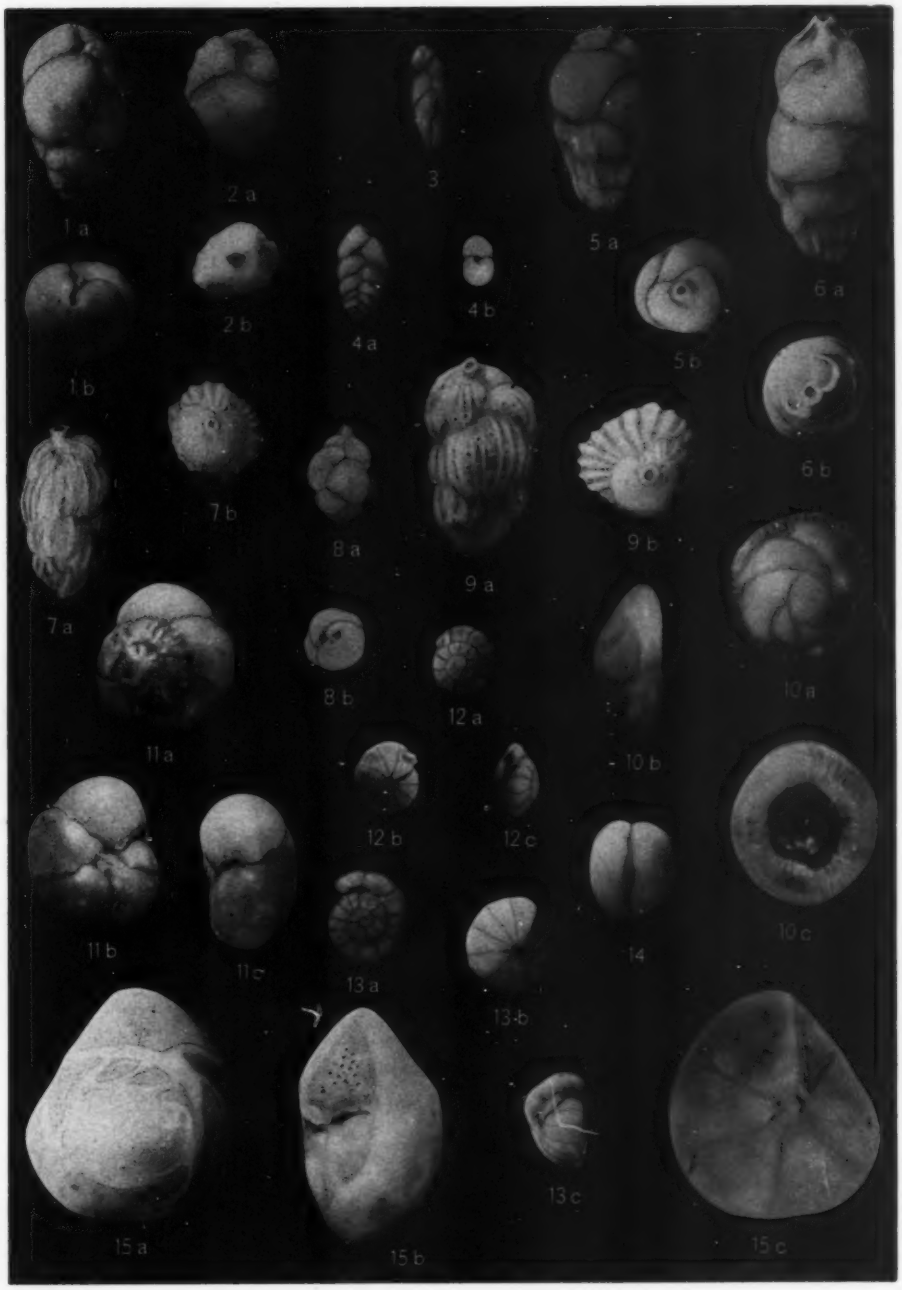
10, 14—Discorbis ornatissima Cushman. *a*, Dorsal view of single specimen. *b*, Peripheral view. *c*, Ventral view. *14*, Two specimens associated in plastogamy. (p. 358)

11—Valvulineria tumeyensis Cushman and Simonson. *a*, Dorsal view. *b*, Ventral view. *c*, Peripheral view. (p. 358)

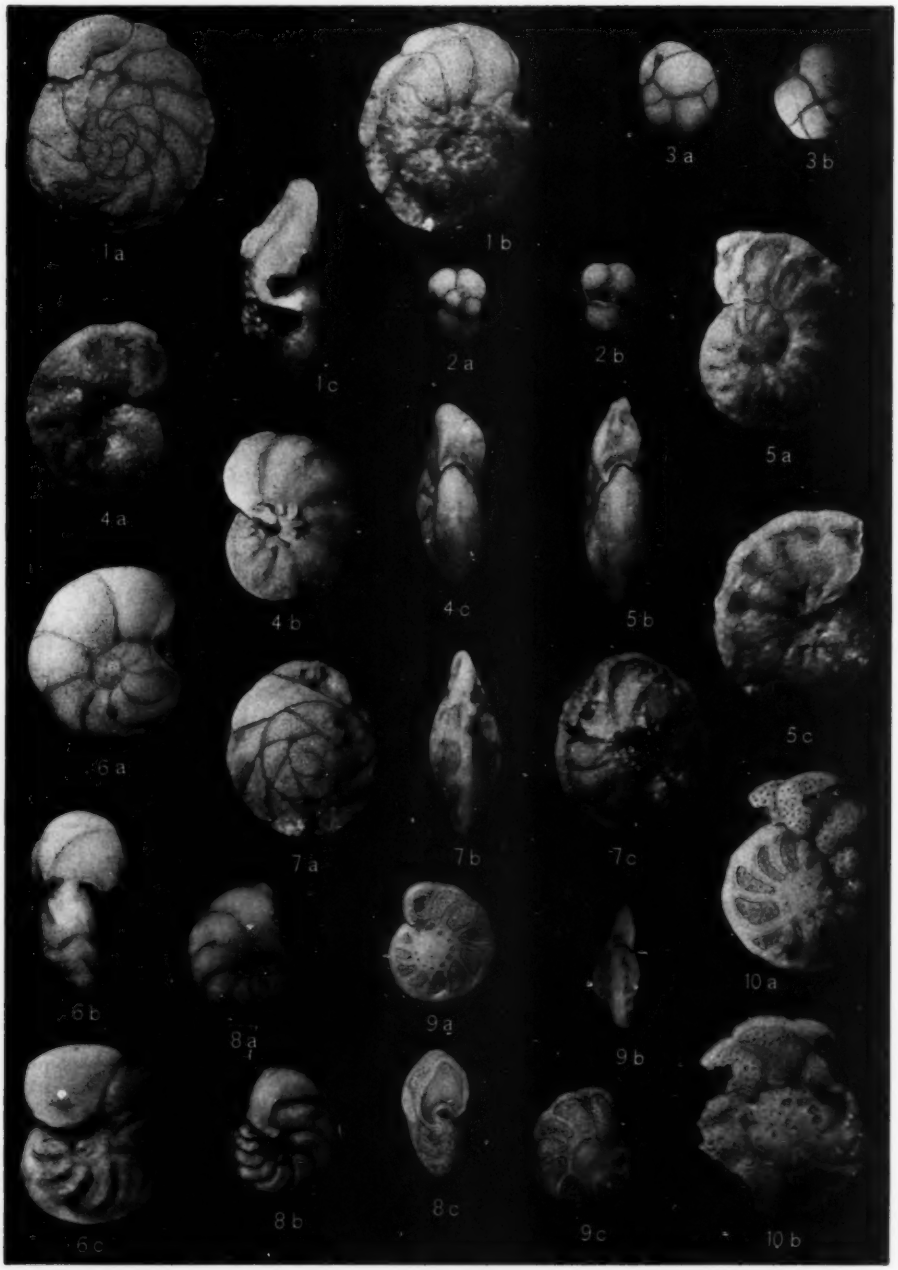
12—Eponides condoni Cushman and Schenck. *a*, Dorsal view. *b*, Ventral view. *c*, Peripheral view. (p. 358)

13—Gyroidina cf. *G. soldanii* d'Orbigny. *a*, Dorsal view. *b*, Ventral view, *c*, Peripheral view. (p. 358)

15—Eponides sp. *a*, Dorsal view. *b*, Peripheral view. *c*, Ventral view. (p. 358)



Detling – Lower Tertiary Foraminifera



Detling – Lower Tertiary Foraminifera

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EXPLANATION OF PLATE 51

All figures ×40

FIGS. *1—Planulina haydoni* Cushman and Schenck. *a*, Dorsal view. *b*, Ventral view. *c*, Peripheral view. (p. 359)

2—Globigerina triloculinoides Plummer. *a*, Dorsal view. *b*, Ventral view. (p. 359)

3—Cassidulina globosa Hantken. *a*, Apertural view. *b*, Side view. (p. 358)

4, 5—Cibicides fenestratus Detling n. sp. Two specimens. *a*, Dorsal views. *4b*, *5c*, Ventral views. *4c*, *5b*, Apertural views. *4*, Paratype. *5*, Holotype. (p. 359)

6, 8—Cibicides hodgei Cushman and Schenck. Two specimens. *6a*, *8b*, Dorsal views. *6c*, *8a*, Ventral views. *6b*, *8c*, Apertural views. (p. 359)

7—Cibicides aff. *C. baileyi* Beck. *a*, Dorsal view. *b*, Peripheral view. *c*, Ventral view. (p. 359)

9, 10—Cibicides pseudowuellerstorfi Cole. *10*, Unusually large specimen. *a*, Dorsal views. *9b*, Peripheral view. *9c*, *10b*, Ventral views. (p. 359)

JOURNAL OF PALEONTOLOGY, VOL. 20, NO. 4, PP. 362–373, PLS. 52, 53, 1 TEXT FIG., JULY 1946

OSTRACODA FROM THE UPPER JURASSIC COTTON VALLEY GROUP OF LOUISIANA AND ARKANSAS[1]

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ABSTRACT—Seven new ostracode species belonging to the new genera *Schuleridea* and *Paraschuleridea* and a new species of *Brachycythere* are described from the Cotton Valley group of the subsurface Upper Jurassic deposits of Louisiana and Arkansas. A ninth species is provisionally referred to *Cypridea wyomingensis*.

INTRODUCTION

THIS paper, the second of a series dealing with Ostracoda obtained from wells penetrating the subsurface Upper Jurassic strata of Louisiana and Arkansas, describes a species of *Cypridea*, together with eight new species, of which six belong to the new genus *Schuleridea*, one to the new genus *Paraschuleridea*, and one to *Brachycythere*. A recent paper by Swain (13) discussed the genus *Hutsonia*, and provides a summary of the Jurassic stratigraphy of the northern Gulf of Mexico region.

With the exception of the species of *Cypridea*, and of one species questionably assigned to *Schuleridea*, the material here described is from the gray shales and interbedded oyster coquinites of the offshore facies of the Schuler formation in northern Louisiana. The specimen of *Cypridea* is from the nearshore and presumably brackish water facies of the Schuler in southern Arkansas. One questionable species of *Schuleridea* was obtained from the upper part of the Bossier formation, which directly underlies the Schuler and forms the lower part of the Cotton Valley group.

In a recent paper, Imlay (7) has described and figured species of *Idoceras* and *Glochiceras* from the Bossier formation of the Phillips' Kendrick No. 1 well, Bossier Parish, Louisiana, that in his opinion furnish strong evidence for correlation with the basal middle Kimmeridgian of Mexico (also see Imlay, 1943, Swain, 1944). The Schuler formation, or upper part of the Cotton Valley group, is regarded as being of Jurassic age younger than middle Kimmeridgian, though the fossils so far discovered in it are not satisfactory for direct correlation. The *Cypridea* here described from the Schuler is very close to *Cypridea wyomingensis* Jones (1893), as interpreted by Peck (1941) from the lower Cretaceous Draney limestone of Wyoming and Idaho. The single specimen shows some variation from the characters depicted by Peck and its value in regional correlation is at present uncertain.

The distribution of Cotton Valley ostracodes here described from well samples is summarized in Table 1. The depths of the upper and lower limits of the Schuler formation in each of the wells are stated at the bottom of the table. *Schuleridea acuminata*, n. sp. and *S. pentagonalis*, n. sp. have each been discovered at numerous levels in cores from the Schuler formation in the Morgan, Smith No. 2 well, and are also represented in well cuttings from several additional wells, so that they may in the future prove to have considerable zonal value. Judging from the present collections, the other species are much rarer.

It is intended, following completion of the study of Upper Jurassic Ostracoda from this region, that a summary statement will be made relative to the possible zonal importance of the various species, together with their comparison to early Mesozoic forms of other parts of the world.

Appreciation is expressed to M. C. Israelsky, Union Producing Company, Houston, Texas, who kindly loaned a fine collection of specimens obtained from well-cores. The type specimens are to be deposited in the U. S. National Museum.

[1] Published by permission of Director of Geological Survey, U. S. Department of the Interior.

SYSTEMATIC DESCRIPTIONS

Order OSTRACODA Latreille
Family CYTHERIDAE Baird, 1850
Genus SCHULERIDEA Swartz and Swain, n. gen.

Shell subovoid in outline, with greatest length subventral in position; dorsal margin strongly convex; ventral margin varying from moderately convex to nearly straight or slightly concave; anterior end broadly rounded; posterior end more narrowly rounded or even pointed, and most extended below.

Left valve larger than right; dorsally, it bears a broad umbo that projects above the more or less straight hinge contact with the right valve; ventrally, the left valve strongly overlaps the right; terminally, the overlap is much less marked.

Right valve bears an antero-cardinal low prominence or node, set off behind by a shallow, oblique furrow; the corresponding features are more poorly defined on the left valve. Surface is finely pitted or smooth.

Internally, the muscle scar is formed by a subvertical row of four small pits, together with a single, more anterior pit. In the genotype, *S. acuminata* n. sp., the hingement, as seen in several specimens by transmitted light, consists of three elements. Anteriorly, the edge of the right valve projects for some distance as an obscurely crenulate tooth, evidently fitting into a corresponding socket of the left valve, though a ventral rim of such a socket has not been demonstrated. Posteriorly, a similar tooth of the right valve is more clearly and strongly crenulate, bearing at least five distinct denticles. Medially, the hinge surface appears to lie nearly in the plane of the external contact line of the valves, but the detailed structure has not been ascertained. Hinge features also have been observed in *S. umbonata*. The right-valve teeth apparently are not crenulated in that species, and hence such crenulation is not regarded as distinctive of *Schuleridea* as here defined.

TABLE 1. DISTRIBUTION OF OSTRACODES IN WELLS. SPECIMENS FROM CORES ARE INDICATED BY SYMBOL (c); THOSE FROM ROTARY WELL CUTTINGS ARE INDICATED BY SYMBOL (ct)

Species	Morgan, Smith No. 2, Bossier Psh., Louisiana	Phillips, Kendrick No. 1, Bossier Psh., Louisiana	Union, McDonald No. A-1, Claiborne Psh., Louisiana	Union, Meadows No. A-1, Claiborne Parish, Louisiana	Hunt, Mitchiner No. 1, Claiborne Parish, Louisiana	Standard, Zimmerman No. 1, Union Co., Arkansas
Schuleridea acuminata, n. gen., n. sp.	4795–4812(c) 4870–87(c) 4937–55(c) 4955–73(c) 5045–63(c) 5474–84(c) 5728–43(c)	5280–90(ct)	7780–90(ct)	8200(ct) 8260(ct)	8270–75(ct)	
S. bellevuensis, n. sp.	5045–63(c)	5620–40(ct)				
S. pentagonalis, n. sp.	4973–91?(c) 5063–81(c) 5200(c) 5277–90(c) 5291–5311(c) 5446–58(c)	5620–40(ct) 6280–90(ct)	8550–55(ct) 9245–50(ct) 9420–25(ct) 9630–35(?)(ct)	8320–30(ct)		
S. umbonata, n. sp.	5045–63(c)		9300–05(ct)			
S. triangularis, n. sp.	5045–63(c) 5063–81(c)	5260–70(ct)		7875–80(ct)		
S. (?) ovoides, n. sp.		6895–6900(ct)				
Paraschuleridea anumbonata, n. gen., n. sp.			8820–25(ct)			
Brachycythere tumidosa, n. sp.				7540–50(ct)		
Cypridea cf. *wyomingensis* Jones						7030(ct)
Limits of Schuler fm.	4730–6127 Total Depth	4950–6505	7470–9590	7320–9120	7060–9065	5503–7758

Genotype. Schuleridea acuminata Swartz and Swain, n. sp.

Relationships. In their general subovate outlines and more particularly the dorsal umbonation of the left valve, the ostracodes here placed in *Schuleridea* are suggestive of species from the Morrison formation of South Dakota that have been assigned to *Bairdiocypris* by Roth (1933) and by Harper and Sutton (1935). In the Devonian species on which *Bairdiocypris* was established by Kegel (1931), the dorsal umbonation of the left valve is indeed well marked; but the antero-cardinal swellings found in *Schuleridea* are apparently lacking, and in *Bairdiocypris rhenana* the muscle scar is seemingly represented by a large, round callosity quite unlike the muscle pattern found in *S. acuminata*, *S. pentagonalis*, and *S. umbonata*. The nature of the hingement and the discreet pits of the muscle pattern, in combination with the general outline, ally *Schuleridea* with *Cytheridea* Bosquet and also are reminiscent of *Xestoleberis* Sars, both of the family Cytheridae, and it seems to the writers that *Schuleridea* belongs with the latter assemblage and not with *Bairdiocypris* and the Bairdiidae. As in *Schuleridea*, the hinge of *Cytheridea* includes on the right valve terminally placed teeth elongate along the valve rim; in *Cytheridea* and its subgenera, however, the hingement, though subject to important evolutionary changes, is always more complex than in *Schuleridea*, and the muscle pattern where known consists of a subvertical row of four small pits together with two anterior pits, not one. Among the subgenera into which *Cytheridea* has been subdivided, the hingement in *Haplocytheridea* Stephenson consists in the right valve of terminal, elongate, markedly crenulate teeth, separated by a crenulate bar, and in *Clithrocytheridea* Stephenson it consists of the terminal, crenulate teeth separated by a crenulate groove. Other members of *Cytheridea* have additional complexities in the area between the terminal dental structures. By contrast, *S. acuminata* has the posterior tooth strongly crenulate, the anterior tooth weakly crenulate, the intervening area not crenulate and not even clearly showing a bar or groove. In *S. umbonata* neither of the terminal teeth is crenulate; in the other species of the genus the hingement is not yet known. It may be that the Jurassic members of *Schuleridea* lie near the ancestral stock of *Cytheridea*, and that the lesser complexity of the hinge reflects this more primitive stage of evolution.

In *Xestoleberis*, the muscle pattern, consisting of a vertical row of four pits with a single anterior pit and in some instances

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EXPLANATION OF PLATE 52

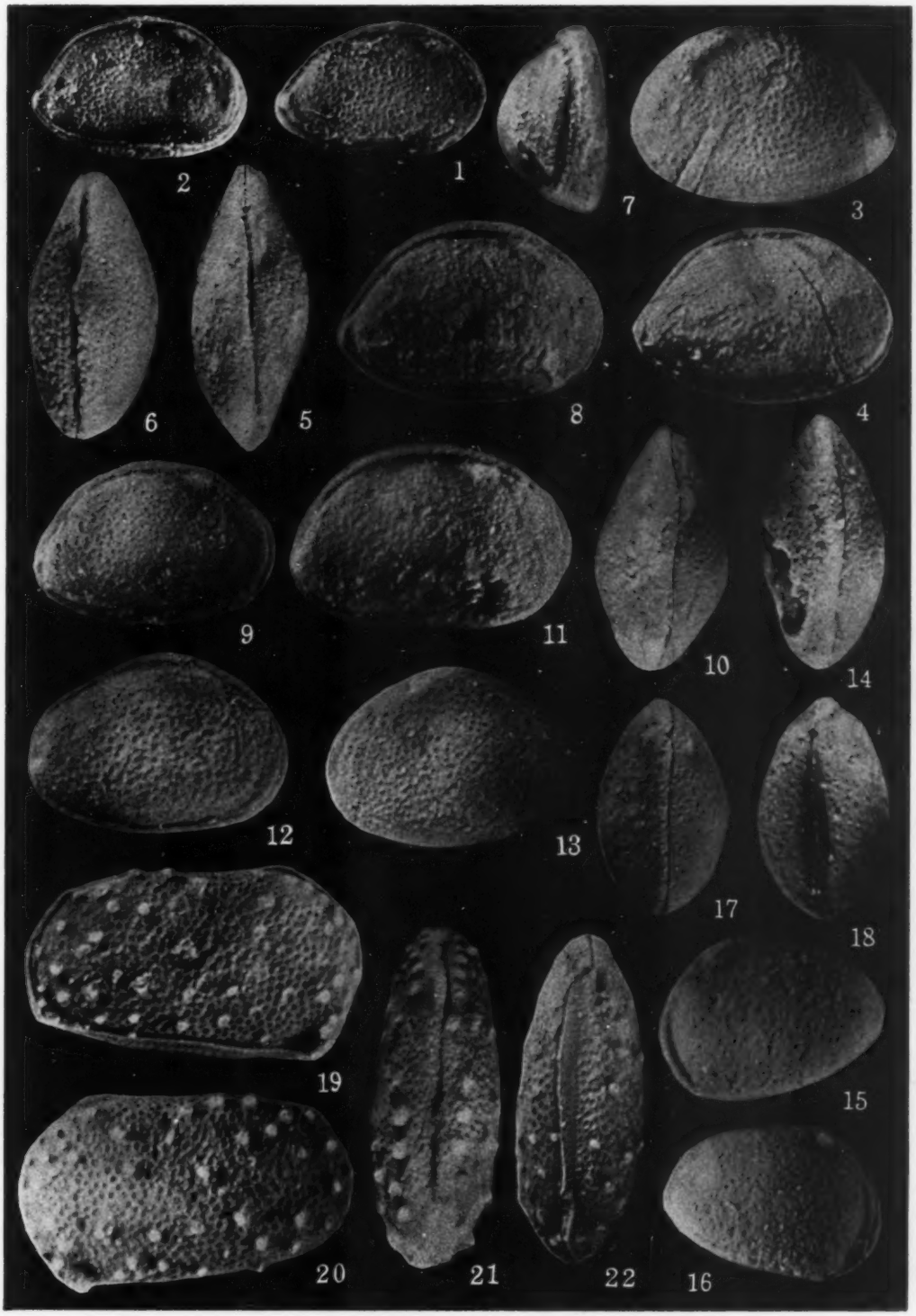
FIGS. *1–10—Schuleridea acuminata* Swartz and Swain, n. gen., n. sp. *1, 2,* Right sides of holotype, a small, complete shell ×52. Core at 4937–55 feet, Dorcheat member of Schuler formation, H. I. Morgan's Smith No. 2 well. *3–5,* Left, right, and dorsal views of a large shell ×55. Well-cutting sample 8270–75 feet, Shongaloo member of Schuler formation, H. L. Hunt's Mitchiner No. 1 well. *6–8,* Ventral, anterior, and right views of a large shell, ×55, in which weak punctation can be observed with favorable lighting. Well-cutting sample, 5280–90 feet, Dorcheat member of Schuler formation, Phillips' Kendrick No. 1 well. *9, 10,* Right and dorsal views of a thick shell ×55. Well-cutting sample, 8260 feet, Dorcheat member of Schuler formation, Union, Meadows No. A-1 well. (p. 366)

11—Schuleridea bellevuensis Swartz and Swain, n. sp. Right side of holotype, a complete shell, ×55. Some fine pitting can be observed with favorable lighting. Well-cutting sample, 5620–40 feet, Dorcheat member of Schuler formation, Phillips' Kendrick No. 1 well. (p. 367)

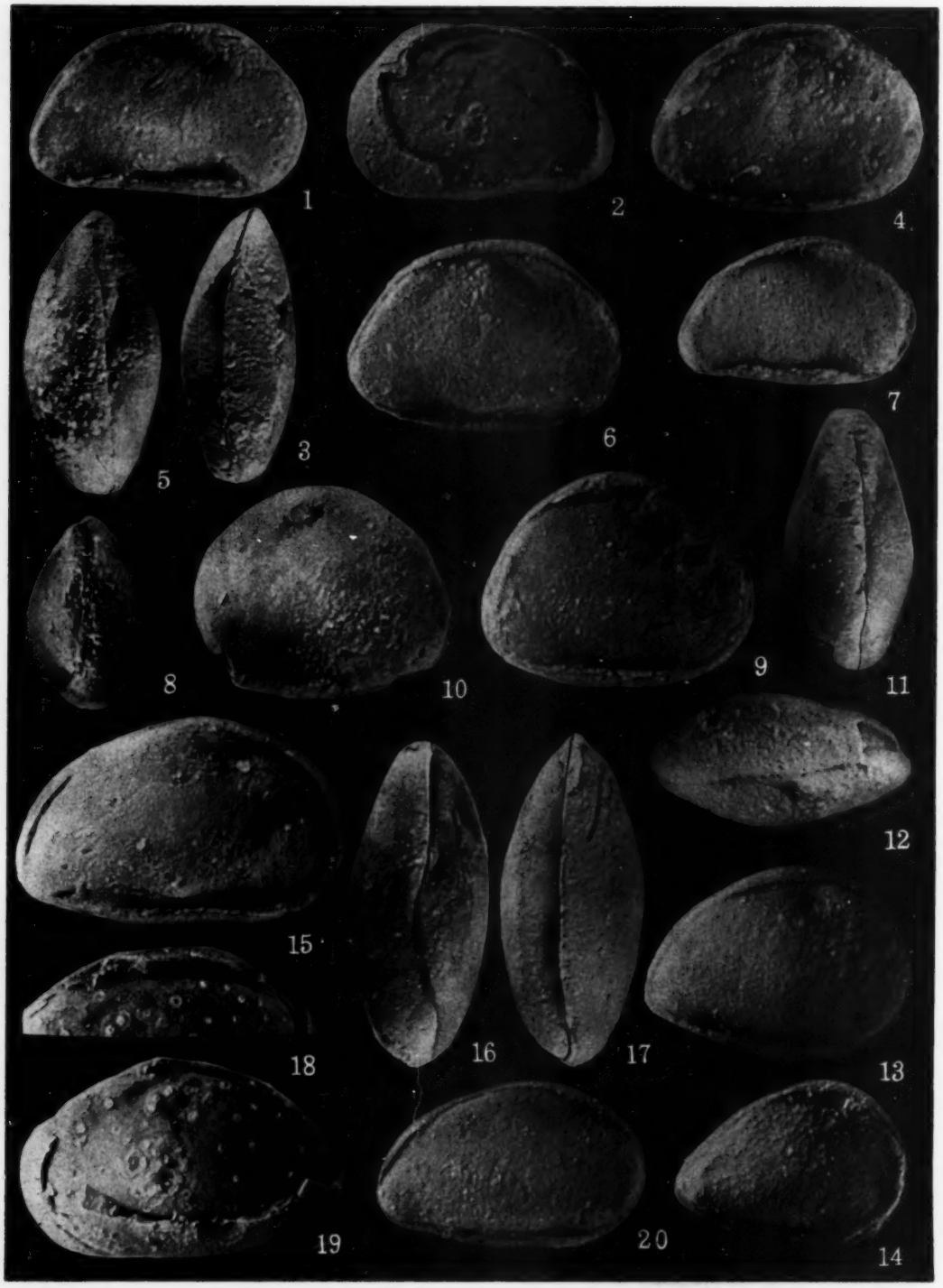
12–14—Schuleridea? ovoides Swartz and Swain, n. sp. Right, left, and dorsal views of holotype; ×55; originally complete, part of the left valve was later removed in an unsuccessful search for the muscle pattern. Well-cutting sample, 6895–6900 feet, upper part of Bossier formation, Phillips' Kendrick No. 1 well. (p. 369)

15–18—Brachycythere tumidosa Swartz and Swain, n. sp. Left, right, dorsal, and ventral views of holotype, ×55. The recessed, median part of the ventrum can be observed in figure 18. Well-cutting sample, 7540–50 feet, Dorcheat member of Schuler formation, Union, Meadows No. A-1 well. (p. 371)

19–22—Cypridea cf. *C. wyomingensis* Jones. Right, left, dorsal, and ventral views of the single specimen, ×55. Well-cutting sample, 7030 feet, nearshore facies of Shongaloo member of Schuler formation, Standard's Zimmerman No. 1 well. (p. 372)



Swartz and Swain – Upper Jurassic Ostracoda



Swartz and Swain – Upper Jurassic Ostracoda

accessory pits, is suggestive of *Schuleridea;* but the anterior end of the shell is much extended, the posterior end tends to be truncated and recessive below, and the hinge elements are strongly crenulated. In the sum total of its features, *Schuleridea* does not seem to be as closely related to *Xestoleberis* as to *Cytheridea.*

The species referred to *Schuleridea* and newly described in the present paper can be arranged in tentative groups as follows:

Group of *Schuleridea acuminata*
S. acuminata, n. sp.
S. bellevuensis, n. sp.
Group of *Schuleridea pentagonalis*
S. pentagonalis, n. sp.
S. umbonata, n. sp.
S. triangularis, n. sp.
Species of doubtful position
S.? ovoides, n. sp.

Schuleridea pentagonalis differs considerably from *S. acuminata* in the more ventral position of the most extended portion of the posterior margin, the broad incurvature and slight median protrusion of the ventral margin of the right valve, and the somewhat broader form and lesser definition of the antero-cardinal nodes. These features are shared in large degree by *S. umbonata* and *S. triangularis*, and hence the three species are tentatively regarded as forming a group in contradistinction to *S. acuminata* and *S. bellevuensis*. In *S. umbonata* the hinge teeth appear to lack the denticulation observed in specimens of *S. acuminata;* but through lack of information about the hinge details of the other species it remains uncertain whether the hinge characters can be used for any type of group arrangement. In *S.? ovoides* the umbonation of the left valve is less pronounced than in the other species assigned to the genus, the limits and details of the hinge are uncertain, and the nature of the muscle pattern is unknown. Inclusion of the species in *Schuleridea* is accordingly very insecure.

Species from the Morrison formation that have been referred to *Bairdiocypris* Kegel by Roth (1933) and by Harper and Sutton (1935) have the left valve umbonate as in *Schuleridea*, and appeared for a time to be probable members of the latter genus. Examples of "*Bairdiocypris*" *morrisonensis* Roth were kindly loaned to the writers by Mrs. Betty Kellett Nadeau and by the

EXPLANATION OF PLATE 53

FIGS. *1–8*—*Schuleridea pentagonalis* Swartz and Swain, n. sp. *1–3*, Right, left, and ventral views of holotype, ×55. Originally a complete shell, part of the left valve was removed to show, in figure 2, the impressions left on the internal mold by the muscle scars. Well-cutting sample, 8550–55 feet, Dorcheat member of Schuler formation, Union, McDonald No. A-1 well. *4, 8*, Right and anterior views of a nearly complete shell, ×55. Well-cutting sample, 6280–90 feet, Shongaloo member of Schuler formation, Phillips' Kendrick No. 1 well. *5, 6*, Dorsal and right views of a shell that is somewhat higher than the holotype, ×55. Well-cutting sample, 9630–35 feet, at a horizon near the top of the Bossier formation but possibly caved from Schuler formation; Union, McDonald No. A-1 well. *7*, Right side of a comparatively elongate shell, ×55. Well-cutting sample, 9245–50 feet, Shongaloo member of Schuler formation, Union, McDonald No. A-1 well. (p. 368)

9–11—*Schuleridea umbonata* Swartz and Swain, n. sp. Right, left, and dorsal views of holotype, a nearly complete shell, ×55. Well-cutting sample, 9300–05 feet, Shongaloo member of Schuler formation, Union, McDonald No. A-1 well. (p. 368)

12–14—*Schuleridea triangularis* Swartz and Swain, n. sp. *12, 13*, Dorsal and right views of holotype, a nearly complete shell, ×55. Well-cutting sample, 7575–80 feet, Dorcheat member of Schuler formation, Union, Meadows No. A-1 well. *14*, Right side of a shell, ×55. The more triangular outline is a result, at least in large part, of abrasion of the post-dorsal slope. Well-cutting sample, 5260–70 feet, Dorcheat member of Schuler formation, Phillips' Kendrick No. 1 well. (p. 369)

15–20—*Paraschuleridea anumbonata* Swartz and Swain, n. gen., n. sp. *15–17*, Right, dorsal, and ventral views of holotype, shown as the original complete shell; *18* and *19* left views of same specimen after much of left valve had been removed to show hingement and molds of muscle scar; in *18* the valve is tilted toward the observer to show furrow where flange of median part of hinge of left valve projected beneath edge of right; denticulation of the anterior tooth is also visible. *20*, Right side of a smaller specimen, all ×55. The two specimens came, respectively, from well-cutting samples at 8820–25 feet (holotype) and 9420–25 feet, Shongaloo member of Schuler formation, Union, McDonald No. A-1 well. (p. 370)

United States Geological Survey, and show features that prevent inclusion in *Schuleridea*. The muscle scar of this species differs in pattern from those observed in *Schuleridea acuminata*, *S. pentagonalis*, and *S. umbonata*, since it consists of a group of four pits or spots, of which three tend to form a subvertical row in front of the fourth, whereas in the *Schulerideas* there is a subvertical row of four spots, with a single, more anterior one. In "*B.*" *morrisonensis*, decidedly greater extension of the anterior end of the shell, and in the absence of antero-cardinal nodes.

Mrs. Nadeau is restudying the Morrison Ostracoda, and expects to propose a new generic name for "*B.*" *morrisonensis* and its close relatives.

Occurrence. The species now referrable to *Schuleridea* are as yet known only from the Schuler formation of the Upper Jurassic deposits of Louisiana.

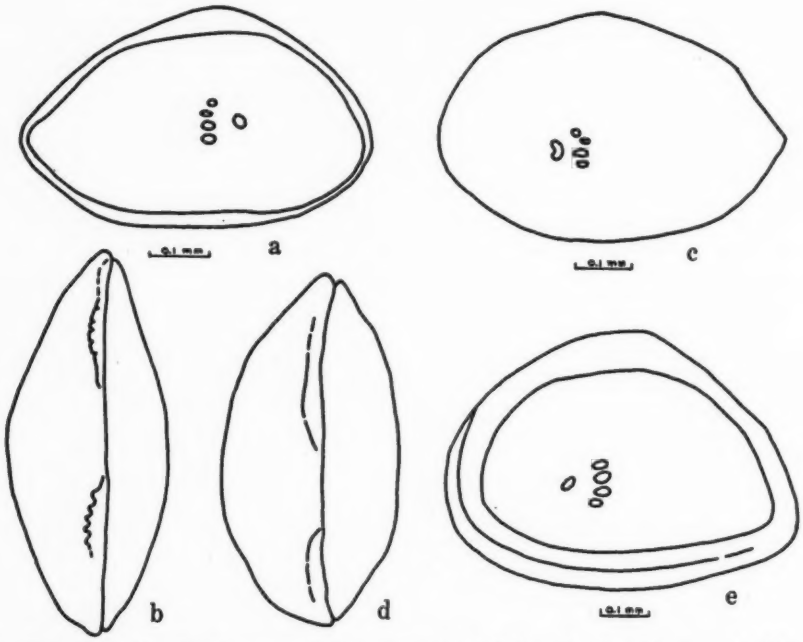


FIG. 1—Camera-lucida drawings, made by transmitted light, showing hinge and adductor-scar features in species of *Schuleridea* Swartz and Swain, n. gen. Scale approximate.

a, *b*, Right and dorsal outline views of holotype of *S. acuminata*, n. sp. (see Pl. 52, fig. 1), showing respectively the form of the adductor scar and the denticulation of the hinge teeth and sockets. In *b*, the details of the median part of the hinge were not determined.

c, Left valve view of a specimen of *S. acuminata* not otherwise figured. Note that the single, more anterior muscle spot is crescent-shaped. Core at 4955–73 feet, Dorcheat member of Schuler formation, Morgan, Smith No. 2 well.

d, *e*, Dorsal and left outline views of *S. umbonata*, n. sp. In *d*, the hinge-teeth are clearly not denticulate, though the structure of the median part of the hinge was not ascertained. In *e*, it is not clear whether the inner line represents the outline of the inner mold of the shell, or the inner margin of the nearer valve.

Core at 5045–63 feet, Dorcheat member of Schuler formation, Morgan, Smith No. 2 well.

furthermore, the hinge does not have the well developed, terminal teeth and sockets found in members of *Schuleridea*.

Externally, "*B.*" *morrisonensis* differs from the known species of *Schuleridea* in the

SCHULERIDEA ACUMINATA Swartz and Swain n. sp.

Plate 52, figures 1–10; text-figures 1a–c

Shell subovoid in outline, with posterior

margin sharply angulated and anterior margin rounded but more extended below, so that greatest length is about one-third above ventral margin. Dorsal margin gently arched medially, bending abruptly into the rather truncated post-dorsal slope and more gently into the curved antero-dorsal bend. Ventral margin moderately convex in the left valve, nearly straight for much of its length in the right.

Left valve larger than right; dorsally, the left umbo projects moderately above the nearly straight hinge contact with the right valve; ventrally, also, the left valve projects well beyond the right; terminally, the projection is less. Free edges of valves are rabbetted, the right valve having a projecting flange that fits inside the edge of the left.

Hinge, as seen by transmitted light in several specimens, consists in the right valve of the following elements: an anterior, elongate, obscurely crenulate tooth; a posterior elongate tooth with at least five distinct crenulations; and a median section in which the hinge surface is about in line with the external contact margin as viewed dorsally, though the contact details are not wholly clear. The hinge teeth appear to be the expanded terminal parts of the rabbet of the right valve.

Muscle scar, as seen in several specimens, lies a little in front of and below valve middle, and consists of a subvertical row of four small pits together with a single, more anterior pit.

Surfaces of valves marked by fine, rather widely spaced, rounded pits. Valves convex, the convexity reaching a maximum near the valve middle as seen in dorsal or ventral view, or close to the ventral margin as seen in end view. Anterior margin of right valve forms an obscure, slightly thickened lip where the surface bends sharply to the contact edge. Posterior end of right valve bears a sharply pointed, posteriorly directed node adjacent to the contact edge; posterior end of left valve has a somewhat thickened, sharp angulation rather than a node. Right valve bears a distinct, rounded, antero-cardinal node, set off behind by a narrow, oblique furrow. Left valve has a low ridge paralleling the antero-cardinal edge, rather than a well defined node.

Dimensions. The holotype measures: length 0.63 mm., height 0.37 mm., thickness 0.31 mm.

Relationships. S. acuminata resembles *S. bellevuensis*, n. sp., but is more pointed posteriorly.

Occurrence. The holotype is from H. I. Morgan's Smith No. 2 well, Sec. 22, T. 19 N., R. 11 W., Bossier Parish, Louisiana. It is from a core at 4937–55 feet, believed to represent a horizon in the Dorcheat member of the Schuler formation.

SCHULERIDEA BELLEVUENSIS Swartz and Swain, n. sp.
Plate 52, figure 11

Shell subovoid in outline, posterior margin gently angulated, anterior margin rounded but more extended below so that greatest length is about one-third distance above ventral margin. Dorsal margin gently arched medially, bending more sharply into post-dorsal than into antero-dorsal slope. Ventral margin moderately convex, but medially straightened in left valve; straight or slightly concave for much of its length in right valve.

Left valve larger than right; left umbo projects dorsally well above the nearly straight hinge contact with right valve; ventral projection of left valve about equal to its dorsal projection; terminal overlap not great.

Details of hinge, overlap, and muscle scars not seen.

Valves moderately convex; in holotype the greatest convexity is submedian in right valve, ventral in left where this valve projects beyond the right; convexity possibly modified by compaction. Right valve with an angulation or obscure node adjacent to posterior edge about one-third distance above ventral margin; left valve gently angulated at corresponding position. A low node occurs close to the antero-cardinal angle in right valve; corresponding node more obscure in left. Surface finely pitted.

Dimensions of holotype; length 0.78 mm., height 0.53 mm., thickness 0.35 mm.

Relationships. Schuleridea bellevuensis is very close to *S. acuminata* in general outline, overlap, and pitting; but the posterior angulations of the valves are much less pronounced, and the post-dorsal slope is less

truncated. The ventral convexity in the left valve of the holotype of *S. bellevuensis* may furnish another distinguishing feature, but it is possible that the specimen may have been slightly modified by compaction.

Occurrence. The holotype is from the Phillips' Kendrick No. 1 well, Sec. 22, T. 19 N., R. 11 W., Bossier Parish, Louisiana, in the Bellevue oil field. It was obtained from cuttings at 5620–40 feet, 665–85 feet below the level of the top of the Dorcheat member of the Schuler formation.

SCHULERIDEA PENTAGONALIS Swartz and Swain, n. sp.
Plate 53, figures 1–8

Shell subpentagonal in outline, dorsal margin gently convex, antero- and postero-dorsal slopes truncated, lower portion of anterior end extended and broadly rounded, lower portion of posterior end extended and narrowly rounded, ventral margin of left valve elongate and gently convex to nearly straight, ventral margin of right valve straight to slightly sinuate.

Left valve larger than right, with umbo projecting well above straight hinge contact; ventrally the left valve projects well beyond right; terminally the projection is less. In ventral view, edge of left valve projects onto right valve as a slightly extended lip for about four-fifths its length.

Hingement not observed; owing to opaque character of matrix the specimens could not be studied by transmitted light and no well preserved free valves are at hand. Muscle scars, shown under oil by reflected light, lie slightly in front of and below the valve middle, and consist of a subvertical, slightly curved row of four small pits, together with a single, more anterior, larger pit.

Surface smooth except for obscure, very minute pitting in terminal regions. Left valve moderately and rather uniformly convex except for the low antero-cardinal swelling and the shallow furrow on its postventral side. Right valve slightly less convex than left, with low antero-cardinal swelling set off behind by a distinct, oblique furrow; ventral slope of valve gently swollen medially.

Dimensions of holotype: length 0.78 mm., height 0.58 mm., thickness 0.38 mm.

Relationships.—Schuleridea pentagonalis is close to *S. umbonata* but is more elongate, and the median portion of the dorsal margin is less arched.

Occurrence. The holotype is from the Union Producing Company's, McDonald Unit A-1 well, Claiborne Parish, Louisiana, North Lisbon oil field. It was obtained from rotary drill cuttings at 8550–55 feet, in the Dorcheat member of the Schuler formation.

SCHULERIDEA UMBONATA Swartz and Swain, n. sp.
Plate 53, figures 9–11; text-figures 1d, e

Shell subovoid in outline, in larger left valve dorsal margin strongly arched and bending gradually into the ends, anterior end broadly rounded, slightly truncated above and more extended below, posterior margin gently convex above, more extended and narrowly rounded below. Greatest length oblique, about one-third distance above ventral margin.

Right valve subpentagonal in outline, with nearly straight dorsal margin, above which rises the strong umbo of left valve. Ends truncated above, ventral margin straight to slightly sinuate. Left valve projects beyond right almost as much ventrally as dorsally; terminally its projection is less marked. Free edges of valves rabbetted, the edge of right valve having a rim that fits into groove of the left.

Hinge, as seen by transmitted light in one specimen, consists in right valve of following elements: at each end a tooth, without observable denticulation, apparently formed by slight enlargment of terminal parts of the rim that fits along free edges into rabbet-groove of left valve; medially, the hinge surface as seen in dorsal view lies about in plane of external valve-contact, but relations of valve edges at this place have not been fully determined.

Muscle scar slightly in front of and below valve middle, consists of a subvertical, slightly curved row of four small pits, together with a single, more anterior, larger pit. The specimen showing hinge and muscle scar in transmitted light appears to have an inner margin which closely parallels the outer valve-margin.

Surface smooth. Valves moderately convex. Right valve with a low, antero-cardinal swelling, set off behind by a shallow, oblique

furrow; corresponding swelling and furrow of left valve less well defined.

Dimensions of holotype: length 0.75 mm., height 0.58 mm., thickness 0.37 mm.

Relationships. *Schuleridea umbonata* closely resembles *S. pentagonalis*, but is more ovoid in outline, with a more strongly arched dorsal margin, so that height is greater in proportion to length, and left umbo is more prominent.

Occurrence. The holotype is from the Union Producing Company's McDonald No. A-1 well, Claiborne Parish, Louisiana, North Lisbon Oil Field; it was obtained from rotary drill cuttings at 9300–05 feet, near the middle of the Shongaloo member of the Schuler formation.

SCHULERIDEA TRIANGULARIS
Swartz and Swain, n. sp.
Plate 53, figures 12–14

Shell ovoid-acuminate to subtriangular in outline, with posterior end ventrally extended and bluntly pointed, anterior margin broadly rounded; greatest length slightly below middle of shell, oblique. Dorsal margin strongly arched, curving gradually into the long, gently convex posterior slope and the more strongly curved anterior margin. Ventral margin gently convex in left valve, nearly straight for much of its length in right valve.

Left valve larger than right; left umbo projects dorsally well above the nearly straight hinge contact with right valve; straight hinge section a little less than half of length of shell, converges posteriorly with ventral margin. Left valve as seen in side view projects ventrally well below the right, and in ventral view laps onto right as a broad lip for about half of length of shell. Inequality of valves slight terminally; here, at least, the valve edges are rabbetted, the right valve having a projecting rim that fits inside the edge of left.

Hinge structure not clear in observed specimens. In one the poorly exhibited muscle scar appears to be composed of a subvertical, slightly curved row of four small pits, together with a more poorly shown, larger anterior pit.

Surface of holotype weakly and minutely pitted, at least in part. Valves moderately convex, somewhat swollen post-medially to medially, the surface being flattened anteriorly, then bending abruptly to the contact edge where anterior margin of right valve forms a slightly thickened lip. Anterocardinal node low, broad, set off behind by a shallow, oblique furrow. Right valve of holotype a little thickened at the sharp, post-ventral bend; in another example there is a small, broken node at this place.

Valve walls pierced by widely spaced, minute pore-canals.

Dimensions of holotype: length 0.72 mm., height 0.53 mm., thickness 0.35 mm.

Relationships. The ventro-posterior marginal bend is much more extended in *S. triangularis* than in the other known species of *Schuleridea* and the hinge and ventral margins are not so nearly parallel.

Occurrence. The holotype is from the Union Producing Company's Meadows No. A-1 well, Claiborne Parish, Louisiana, North Lisbon oil field. It was obtained from rotary drill cuttings at 7875–80 feet, at the horizon of the Dorcheat member of the Schuler formation.

SCHULERIDEA? OVOIDES Swartz
and Swain, n. sp.
Plate 52, figures 12–14

Shell subovoid in outline; dorsal margin convex, strongly arched medially, with greatest height slightly in front of middle. Anterior to greatest height, the dorsal margin is gently convex for some distance, then passes into the extended and more sharply curved ventral portion of the anterior margin. Posterior to the greatest height, the dorsal margin is nearly straight for almost half the shell length, then bends into the sharply curved posterior end. Ventral margin gently convex.

Left valve larger than right; with its edge projecting moderately and almost uniformly beyond the margin of right valve except for a short distance along the dorso-median section where there is a slight umbonation.

Hinge details and position not clear; it is not certain whether the hinge lies along the straight section of the right valve margin below the left umbo, or whether it is longer and extends along the nearly straight post-median section of the dorsum. In the holotype, as viewed by transmitted light, no evidence of hinge teeth could be found al-

though the specimen is reasonably translucent. The muscle scars are not visible by either transmitted light or reflected light under oil.

Surface of valve marked by fine, rather widely spaced, rounded pits. Valves strongly convex, greatest convexity slightly behind and below middle. Right valve bears a small, inconspicuous antero-cardinal node; a corresponding swelling on left valve is broader but more obscure.

Dimensions of holotype and only known specimen: length 0.73 mm., height 0.51 mm., thickness 0.37 mm.

Relationships.—Schuleridea? ovoides differs markedly from the other species assigned to the genus in the inconspicuousness of the left valve umbo, and the shortness of the associated straight section of the valve contact.

The posterior margin of the holotype is slightly damaged, but it appears to be rounded, without the sharply curved to pointed post-ventral projection of the other species of the genus. These outline characters, together with apparent lack of terminal hinge teeth and uncertainty about the nature of its muscle scars, makes reference of this species to *Schuleridea* very insecure.

Occurrence. The holotype is from a rotary-well cutting sample, Phillips Petroleum Company's Kendrick No. 1 well, Bellevue oil field, Bossier Parish, Louisiana, 6895–6900 feet, in the upper part of the Bossier formation.

Genus PARASCHULERIDEA Swartz and Swain, n. gen.

Shell subovate-acuminate in lateral outline, with greatest length below middle; dorsal margin convex; ventral margin nearly straight for much of its length; anterior end broadly rounded; posterior end more narrowly and irregularly rounded, most extended below.

Left valve larger than right, overlapping upon and projecting beyond the other along the free edges, but not rising much above the right valve along the hinge.

Right valve bearing a low antero-cardinal prominence, set off behind by a shallow, oblique furrow; corresponding features more poorly defined in the left valve.

Internal muscle scar formed of a subvertical row of four small pits, together with a single, more anterior pit. Hinge as observed externally appears about half of length of shell, consists in right valve of terminal, elongate teeth, fitting into sockets of left valve; between which edge of left valve projects as a rabbetted flange overlapped by edge of right valve.

Genotype. Paraschuleridea anumbonata Swartz and Swain, n. sp.

Relationships. Paraschuleridea closely simulates *Schuleridea*, especially the section of *S. pentagonalis*, in general character of outline, nature of the muscle pattern and form of the terminal hinge teeth; but differs by lacking the prominent umbo of the left valve. In the genotype and only known species, the right valve strongly overlaps the left along the middle section of the hinge.

Occurrence. Paraschuleridea is known only from the Schuler formation of Louisiana.

PARASCHULERIDEA ANUMBONATA Swartz and Swain, n. sp. Plate 53, figures 15–20

Shell subovoid-acuminate in lateral view, greatest length below middle; dorsal margin strongly convex with greatest height about two-fifths distance from anterior end; ventral margin nearly straight for much of its length; anterior end broadly rounded, slightly truncated above; posterior end more narrowly rounded, most extended below, where it is subacuminate in right valve.

Left valve larger than right, overlapping upon and projecting beyond the other along free edges, but not rising appreciably above right valve along hinge.

Right valve bears a low antero-cardinal prominence, set off behind by a shallow, oblique furrow; corresponding features inconspicuous on the opposite valve. Surface smooth.

Internally, muscle scar consists of a subvertical, slightly curved row of four small pits, their floors elevated medially, together with a single, more anterior pit. Inner surface of valve has distant, shallow, rounded depressions that are mouths of smaller pores, penetrating shell wall. Hinge in right valve consists of terminal, elongate teeth; anterior tooth weakly crenulate, posterior tooth not observably so. Edge of left valve between the teeth projects as a strongly developed,

rabbetted flange overlapped by a corresponding. flange-like part of right valve; as observed in dorsal view, the overlapping hinge-flange of right valve projects slightly beyond the projected line of external contact of anterior and posterior margins.

The holotype, a complete shell when originally studied, but now having the left valve largely removed to show the muscle scars and hingement, measured: length 0.92 mm., height 0.55 mm., thickness 0.38 mm.

Occurrence. The holotype was obtained from a well-cutting sample, Union Producing Company's McDonald No. A-1 well, North Lisbon oil field, Claiborne Parish, Louisiana, at 8820–25 feet, in the upper part of the Shongaloo member of the Schuler formation.

Genus BRACHYCYTHERE Alexander, 1933

BRACHYCYTHERE TUMIDOSA Swartz and Swain, n. sp.

Plate 52, figures 15–18

Shell in side view subovate to subtriangular in outline; hinge margin about straight for half or a little more than half of shell length; anterior end high, broadly rounded, most extended ventrally; posterior end more narrowly and irregularly rounded; ventral margin with a slightly curved portion, about three-fourths of shell length, strongly oblique to the hinge, so that greatest height is about one-third distance from anterior margin.

Valve strongly convex, reaching its maximum slightly below and just behind middle. Outer margins of a broad flattened ventrum produce an inconspicuous ala on each valve whose rounded crest forms the oblique, nearly straight section of ventral margin as shell is viewed laterally. Margins of valves somewhat impressed close to their contact line along ventrum. A narrow lip occurs along antero-ventral margin. Anterocardinal nodes small but distinct, that of left valve being closer to the valve-edge and somewhat less elevated than that of right valve. Surface smooth, except for a few scattered pits.

Valves nearly equal; only observed overlap along anterior margin where left valve extends slightly over right; dorsal margin of left valve only slightly elevated above that of right.

When viewed dorsally by transmitted light, the hinge contact of the holotype is clearly visible, but it lacks observable teeth or crenulations, and appears to be simple. The interior of the holotype is crystalline, giving a strong pattern that masks and obscures the muscle scars. The only other example of the species at hand, a separated valve affixed to a fragment of matrix, provides no additional information as to inner structure.

Dimensions of holotype, a complete shell: length 0.61 mm., height 0.43 mm., thickness 0.35 mm.

Relationships. In the marked rearward convergence of the hinge and ventral margins, the ventral alation, the narrowly rounded posterior end, and the straight hinge and associated antero-cardinal tubercles, *B. tumidosa* is strongly reminiscent of the genotype *B. sphenoides* (Reuss). (See Alexander, 1933.) Nevertheless, reference of *B. tumidosa* to this genus is questionable because of the absence of pronounced dorsal protrusion of the left valve over the right. Furthermore, the characteristic compression and denticulation of the terminal margins of the shell are missing, and strong hinge teeth such as those of *B. sphenoides* are apparently absent. Separation from *Brachycythere* does not seem possible at present because the muscle scar pattern has not been observed and there is some uncertainty as to details of hingement. *B. tumidosa* may be regarded at present as an early and uncharacteristic member of the genus.

The comparatively short, subtriangular outline of *B. tumidosa* is reminiscent of *B. jessupensis* Howe and Garrett (1934), from the Eocene Wilcox group of Louisiana, but the latter differs in having compressed ends, strong left dorsal overlap, sharp alae, and terminal hinge teeth characteristic of typical members of *Brachycythere.*

Occurrence. The holotype was obtained from a well cutting sample, Union Producing Company's Meadows No. A-1 well, North Lisbon oil field, Claiborne Parish, Louisiana, at 7540–50 feet, in the Dorcheat member of the Schuler formation.

Family CYPRIDAE Baird, 1846
Genus CYPRIDEA Bosquet, 1852
CYPRIDEA cf. C. WYOMINGENSIS Jones
Plate 52, figures 19–22

Cypridea tuberculata var. *wyomingensis* Jones, 1893, Geol. Mag., decade 3, vol. 10, p. 386, pl. 15, figs. 5a, b; 6a, b.
Cypridea wyomingensis, Peck, 1941, Jour. Pal., vol. 15, p. 297, pl. 43, figs. 10–17.

Shell elongate, nearly subquadrate in lateral outline, highest anteriorly; hinge margin nearly straight for three-fourths of shell length; anterior cardinal angle projecting slightly on left valve; anterior end broadly rounded, slightly truncate above, more extended below, where it projects as a moderately-sized beak at the abrupt bend to the ventral margin; ventral margin nearly straight for about four-fifths of shell length; posterior end rounded, its height about three-fourths that of anterior end; posterior margin slightly more extended below than above, bending more sharply into ventral than into dorsal margin.

Left valve larger than right; ventral edge of left valve, as observed in ventral view, projects behind the antero-ventral beak as a wide, broadly curved flange for nearly three-fourths of shell length; overlap is much weaker along terminal margins; ventral flange of left valve narrows rapidly just behind antero-ventral beak, so that beak of right valve is a boss not covered by margin of left valve. The ventral flange of left valve also narrows as it reaches postero-ventral angulation of shell.

Details of hinge and muscle scars not observed.

Surface of valves moderately convex; a broad, very obscure depression occurs in the dorsal half of valve just anterior to mid-length; posteriorly the dorsal part of valve is slightly swollen and projects slightly above hinge. Narrow, weak border along anterior margin. Antero-ventral beak defined on its posterior side by a well-marked furrow or notch. Surface finely punctate, interspaces about as wide as pits. Small, distant pustules scattered over surface.

Dimensions of figured specimen: length 0.94 mm., height 0.54 mm., thickness 0.35 mm.

Relationships. A single specimen from the Schuler formation agrees very closely with examples of *Cypridea wyomingensis* Jones as figured by Peck (1941) from the Lower Cretaceous Draney limestone of Idaho and Wyoming. Its dorsal and ventral margins also are nearly straight and converge posteriorly. The posterior and especially the anterior cardinal angles are prominent, the surface is punctate, with about five to seven pits in 0.2 mm., and there are scattered tubercles, including an oblique row of three that are adjacent to the posterior part of the dorsal margin. The antero-ventral beak is defined on its posterior side by a well-marked notch, but is itself somewhat less extended than those of most of the Draney examples; the dorsal and ventral margins converge posteriorly at an angel of about 13° as compared to about 17° in typical *C. wyomingensis*, although Peck states that two specimens referred to that species have the dorsal and ventral margins much more nearly parallel. The inter-spaces between the surface pits are narrower and the pustules smaller in the Schuler specimen than they appear to be in the Draney examples as shown in Peck's illustrations, but this may be a matter of retouching. In the Schuler form, the ventral flange of the left valve is broadly curved, and has a flattened, non-punctate marginal portion; as illustrated by Peck, the flange terminates abruptly at the beak, and its edge is not appreciably curved. If these apparent differences are confirmed by reexamination of collections from the Draney limestone and by discovery of additional examples from the Schuler formation, it may be desirable to recognize the latter as a variety of the former.

Occurrence. The figured specimen was obtained from a rotary well cutting sample, Standard Oil Company's Zimmerman No. 1, Sec. 29, T. 18 S., R. 16 W., Union County, Arkansas, at 7030 feet, about 1530 feet below the top of the Schuler formation, at a horizon in the Shongaloo member of that formation. This well lies just north of the principal belt of color change within the Schuler formation (Swain, 1944, p. 587), and here the Shongaloo member consists of red beds. The specimen of *Cypridea* represents the only known occurrence of invertebrates in the nearshore parts of the Schuler.

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OSTRACODA FROM THE TERTIARY OF FLORIDA[1]

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ABSTRACT—Ostracodes referable to the genera *Cytherella*, *Bythocypris*, *Bairdia*, *Cythereis*, *Leguminocythereis*, *Cytheridea*, and *Cytheretta* are described from the Oligocene, Eocene, and Paleocene of Florida.

INTRODUCTION

THIS paper records the study of a collection of Tertiary ostracodes obtained by Esther R. Applin and Paul L. Applin from wells in Florida. Owing to the present activity in the search for oil in the Southeastern States, it has seemed desirable to make the results available as soon as possible, in order that the information may be used by geologists working in the region. The writer's time for this work has been limited, and a number of problems that presented themselves during the study must remain unsolved for the time being.

Difficulty was experienced in the generic assignment of species of the general *Cythereis* group. *C. bicarinata*, n. sp., *C. parexanthemata*, n. sp., and *C. chinsegutensis*, n. sp., all have narrow antero-marginal rims and compressed posterior ends, and are slightly alate postero-ventrally, although without the prominent alae of the subgenus *Pterygocythereis*. These three species are more or less typical of *Cythereis* of authors. The species here designated as *Cythereis? okeechobiensis*, n. sp., *Leguminocythereis? applinorum*, n. sp. and *L.? corrugata*, n. sp., essentially lack the characters of the group mentioned above, and their generic status is uncertain. The same statement applies to a number of species in the Tertiary of Maryland and elsewhere that have been called *Cythere*. A number of authors have cited Blake's restriction of that genus (Blake, 1931). This restriction left in uncertain position a number of highly ornamented species that lack the other features of typical *Cythereis* and that are much in need of further consideration.

Owing to condition of preservation of the specimens, the writer was able to observe very little as to the line of concrescence, inner margin, and muscle scar pattern in the material studied. Examination in search of these features was made both by reflected and by transmitted light under oil.

A recent comprehensive publication by Paul L. Applin and Esther R. Applin (1944) will provide the reader with the stratigraphic classification and relationships of the rocks from which the collections were obtained. Following is a list of the ostracode species here described, arranged in stratigraphic sequence:

Oligocene, undifferentiated
- *Bairdia wauchulensis*, n. sp.
- *Cytheridea* (*Haplocytheridea*) *blanpiedi* Stephenson
- *Cytheretta howei*, n. sp.

Eocene
- Ocala limestone, undifferentiated
  - *Cytherella* sp. a
  - *Bythocypris? gibsonensis* Howe and Chambers
  - *Cythereis bicarinata*, n. sp.
  - *C.? okeechobiensis*, n. sp.
- Lower part of Ocala limestone
  - *Cythereis bicarinata*, n. sp.
  - *C. parexanthemata*, n. sp.
  - *Cytheretta? daytonaensis*, n. sp.
- Avon Park limestone
  - *Bythocypris? gibsonensis* Howe and Chambers
  - *Bairdia* sp. aff. *B. woodwardensis* Howe and Law
  - *Cythereis chinsegutensis*, n. sp.
  - *Leguminocythereis? applinorum*, n. sp.
- Tallahassee limestone
  - No ostracodes
- Lake City limestone
  - *Leguminocythereis? corrugata*, n. sp.
- Oldsmar limestone
  - No ostracodes

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Paleocene
Cedar Keys limestone
Cytherella sp. b
Cythereis aff. *C. sculptilis* Alexander
Cytheridea sp.

The type specimens have been deposited in the U. S. National Museum.

DESCRIPTION OF SPECIES

Order OSTRACODA Latreille
Family CYTHERELLIDAE Sars, 1865
Genus CYTHERELLA Jones, 1849
CYTHERELLA sp. a
Plate 54, figures 3 a–b

Five specimens of *Cytherella* are present in the collection from the Ocala limestone, well 1500 feet east of post office at Babson Park, Polk County, Florida, at 320–30 feet. The evidence at hand is insufficient to provide specific designation of the material. As seen in side view, the right valve is slightly angulated at the antero-ventral bend.

U. S. Nat. Mus. 103763.

CYTHERELLA sp. b.

A single, poorly preserved specimen from Cedar Keys limestone, Van Horn and Gritchlow well, one mile north of Polk City, Florida, at 2570 feet, is similar in outline to *C. symmetrica* Alexander, which occurs rarely in the Midway of Texas. The Cedar Keys specimen does not have preserved the characteristic obscure anterior marginal rim of *C. symmetrica*.

Family CYPRIDAE Baird, 1846
Genus BYTHOCYPRIS Brady, 1880
BYTHOCYPRIS? GIBSONENSIS Howe and Chambers, 1935
Plate 54, figures 4 a–e

Several specimens of *Bythocypris* which appear to belong to this species are present in the collection from the Avon Park limestone, well at Sanford, Seminole County, Florida, at 105 feet, and from the Ocala limestone, well of city of Eau Gallie Brevard County, Florida, at 300 feet. The species is found in beds of Jackson age in Louisiana, Mississippi and Alabama, and the Florida occurrence extends its range downward into beds of upper Claiborne age.

U. S. Nat. Mus. 103764, 103765.

Family BAIRDIIDAE Sars, 1887
Genus BAIRDIA McCoy, 1841
BAIRDIA WAUCHULENSIS Swain, n. sp
Plate 54, figures 1a–d

Shell subtriangular in side view; dorsal margin strongly arched; hinged portion of valve straight, slightly posterior to valve middle, a little less than one-third of valve length, converging posteriorly with respect to the ventral margin; dorsum slightly angulated at ends of hinge; antero- and posterodorsal slopes of about the same length, but the latter is the steeper as seen in side view. Anterior end broadly and uniformly rounded below dorsal slope, its bend lying at midline of valve; posterior end bluntly pointed, most extended below midline of valve, so that greatest length is oblique. Greatest height slightly anterior to middle of valve. Left valve larger than right, overlapping it around entire periphery; overlap greatest along ventral one-half, least at the ends; dorsal margin of left valve not projecting much above the right as seen in side view.

Surface of valves smooth.

Muscle scar lies slightly below but only scarcely anterior to valve middle. It consists of two small central spots with six additional spots arranged in a roughly circular pattern around them.

Edge of the right valve fits into a groove in the left along hinge. A narrow groove is present on the hinge-face of the right valve; this presumably receives a slight ridge bounding the upper border of the groove on the left valve.

Dimensions of holotype: length 1.21 mm., height 0.83 mm., thickness 0.67 mm.

Relationships. In general outline and degree of left-valve overlap, this species is close to *B. subdeltoidea* (Muenster), as figured by Howe (5) from the Oligocene Red Bluff clay of Alabama. As compared to *B. subdeltoidea*, however, its hinge converges posteriorly with respect to the ventral margin, instead of being nearly parallel to that margin. The posterior end of *B. wauchulaensis* is lower than that of *B. subdeltoidea*, causing the greatest length to lie in an oblique position. *B. hiwanneesis* Howe and Law, from the Vicksburg of Louisiana, is relatively longer with respect to its height than the species under discussion, and the

posterior end is less pointed and lower in position. *B. hazzardi* Howe and Law has a lower posterior end and a more sharply bent anterior end than *B. wauchulaensis*.

Occurrence. Oligocene; obtained from well four miles east of Wauchula post office, Hardee County, Florida, at 470 feet.

Holotype: U. S. Nat. Mus. 103767; paratypes: U. S. Nat. Mus. 103766

BAIRDIA sp. aff. B. WOODWARDENSIS
Howe and Law, 1936
Plate 54, figures 2a–b

Several poorly preserved *Bairdia*-like specimens are present in the collection from the Avon Park limestone, Florida Geological Survey well no. W 594, Seminole County Florida, at 105 feet.

These have the same general shape as *B. woodwardensis* Howe and Law, of the Byram formation, Marianna limestone, and Red Bluff clay of Oligocene age in Mississippi and Alabama, but details of overlap and other features are lacking.

U. S. Nat. Mus. 103768.

Family CYTHERIDAE Baird, 1850
Genus CYTHEREIS Jones, 1849
CYTHEREIS BICARINATA Swain, n. sp.
Plate 54, figures 7a–d; plate 55, figures 1a–e

Shell subquadrate in side view; left valve larger than right; right valve highest about one-third the distance from the anterior end; left valve highest at anterocardinal angle; dorsal margin of both valves nearly straight; ventral margin of right valve nearly straight to slightly convex, ventral margin of left valve slightly convex; anterior end broadly rounded and in some specimens finely denticulate, slightly extended below; posterior end spinose, much extended below, the spines being thick, blunt, and numbering three to five; greatest length sub-median in left valve, about median in right valve.

Surface of valves strongly sculptured, with high, narrow, anterior rims, and prominent eye tubercles; inner margins of anterior rims bounded by deep, reticulate furrows; eye tubercles defined posteriorly by narrow, oblique sulci. A pair of well-defined, high, medial ridges trending about parallel to dorso-ventral margins lie in the anterior half of each valve, and are imperfectly developed in the posterior half; ridge surfaces highest in central portions of valves; surface of left valve adjacent to these ridges imperfectly reticulate, surface of right valve between and below ridges imperfectly reticulate, and above ridges only slightly reticulate. About one-fifth distance from posterior end, surface raised into a discontinuous, subvertical, ridge-like process which ends dorsally beyond the margin in an acumination and extends nearly to the margin ventrally; posteriorly the surface slopes steeply into a flattened, partly reticulated rostrum which is bounded by the terminal spines; greatest convexity median.

Hinge slightly more than one-half length of shell; that of right valve consisting of a rounded anterior tooth, a sub-rounded posterior tooth, and intermediate narrow almost straight hinge-groove expanding into a small socket adjacent to the posterior tooth. Hinge of left valve consists of a deep anterior socket and postjacent rounded tooth, a rounded posterior socket, and an intermediate narrow knife-edge bar which is the valve edge and is bounded dorsally by a faint groove.

As seen by transmitted light under oil, marginal pore canals numerous, closely spaced; line of concresence not coinciding with inner margin in antero-ventral area of left valve, otherwise not clearly observed; muscle scar pattern not observed owing to condition of preservation.

Dimensions of holotype: length 0.75 mm., height 0.45 mm., thickness 0.43 mm.

Relationships. C. bicarinata is very close to *C. collei* Gooch from the Cook Mountain formation of Winn Parish, Louisiana, but differs mainly in possessing only two ridges in the anterior half of the shell, whereas *C. collei* bears three such ridges.

Occurrence. Ocala limestone, Eocene, well 1500 feet northeast of post office at Babson Park, Polk County, Florida, 320–330 feet (holotype); also lower part of the Ocala limestone, Daytona Beach well, Volusia County, Florida, 135–160 feet.

Holotype: U. S. Nat. Mus. 103769; paratypes: U. S. Nat. Mus. 103770, 103771.

CYTHEREIS CHINSEGUTENSIS
Swain, n. sp.
Plate 54, figures 9a–b; plate 55, figures 2a–c

Shell subquadrate to subovate in side view; valves approximately the same size; greatest height about one-fourth distance from anterior end; greatest length slightly below middle. Dorsal margin, as seen in side view, slightly concave in anterior one-half, slightly convex behind, ventral margin moderately convex, the valve edges being impressed for a short distance about one-third from anterior end. Anterior end broadly rounded, somewhat extended below; posterior end narrowly rounded, extended below, and bearing a few, short, blunt spines.

Eye tubercles well defined, lying just below the high antero-cardinal angles. A short, broad sulcus, directed obliquely forward, lies just behind antero-cardinal angle on each valve. Viewed ventrally, the ventral surface is produced into short alae, about one-fifth of distance from posterior end; surface compressed behind alae. A narrow, crenulate, marginal rim present on anterior end of each valve. Surface of shell coarsely and deeply reticulate. Greatest convexity about median.

Hinge structure of left valve, as seen in one separated specimen, consists of the following elements: an anterior socket and postjacent rounded tooth, a rounded, terminal, posterior socket, and a narrow ridge connecting the terminal dental areas. Posterior end of connecting ridge expanded to form a blunt tooth. A narrow, shallow groove bounds the connecting ridge dorsally.

Other features of internal structure could not be seen owing to condition of preservation.

Dimensions of holotype: length 1.00 mm., height 0.59 mm., thickness 0.54 mm.

Relationships. *C. florienensis* Howe and Chambers, from the Eocene Jackson formation of Louisiana, has a reticulate pattern of surface ornamentation similar to that of this species but its dorsal margin is nearly straight, and its posterior end is most extended above the midline rather than below it. The hingement of the two species is apparently very similar.

Occurrence. Avon Park limestone, Chinsegut Hill well, Hernando County, Florida, 390 feet.

Holotype: U. S. Nat. Mus. 103772; paratypes: U. S. Nat. Mus. 103773.

CYTHEREIS PAREXANTHEMATA
Swain, n. sp.
Plate 54, figures 8a–b; plate 55, figures 4a–c

Shell subquadrate in side view; dorsal margin nearly straight, about three-fourths length of shell; ventral margin nearly straight, converging slightly backward with respect to dorsal margin. Anterior end broadly rounded, extended below; posterior end more narrowly rounded, greatest height about one-fourth distance from anterior end at anterior cardinal angle; greatest length slightly sub-median, somewhat oblique; greatest thickness slightly posterior to middle. Valves about equal in size.

Anterior marginal compressed rim-like area has a width equal to about one-sixth shell-length; posterior marginal compressed area narrower. Ventral surface produced into short alae about one-third distance from posterior end. Surface studded with rather large, closely spaced spines.

Hinge of right valve consists of a terminal anterior rounded tooth and postjacent rounded socket, and a terminal posterior rounded tooth. The connection between the terminal dental areas is formed by the ridge-like valve edge. Hinge of left valve not observed. Other internal features obscured by matrix in specimens at hand.

Dimensions of holotype: length 0.81 mm., height 0.45 mm., thickness 0.45 mm.

Relationships. This species is close to *C. exanthemata* (Ulrich and Bassler), from the Miocene of the Atlantic and Gulf Coastal regions, but the latter is considerably more coarsely spinulose.

Occurrence. Lower part of Ocala limestone, Florida Geol. Survey well no. W-239, Lake County, Florida, 160–172 feet.

Holotype: U. S. Nat. Mus. 103774; paratypes: U. S. Nat. Mus. 103775, 103776.

CYTHEREIS aff. C. SCULPTILIS
Alexander, 1934
Plate 54, figure 5

A poorly preserved specimen having

questionable affinity with this Midway species is present in the collection from the Cedar Keys limestone, Van Horne and Gritchlow well, one mile north of Polk City, Florida at 2570 feet. The Cedar Keys specimen is higher with respect to its length than is the Midway form, and there is scarcely any development of a median longitudinal ridge.

U. S. Nat. Mus. 103777.

CYTHEREIS? OKEECHOBIENSIS Swain, n. sp.
Plate 54, figures 10a–b; plate 55, figures 3a–b

Shell sub-ovate in side view; dorsal margin slightly concave just anterior to middle, convex elsewhere; ventral margin in general gently convex, but slightly concave and impressed just anterior to middle. Anterior end broadly rounded, scarcely extended below; posterior end narrowly rounded, most extended medially or slightly below midline; posterior end compressed. Greatest height about one-fourth distance from anterior end at antero-cardinal angle; greatest length about median; greatest thickness slightly post-median. Valves about equal in size, the left only slightly larger than the right.

Eye tubercles prominent, lying at antero-cardinal angles, and bounded posteriorly by short, oblique sulci. Surface studded with numerous closely spaced, short spines, arranged in a roughly concentric pattern.

Hinge of a separated right valve consists of an anterior rounded tooth and postjacent socket, a posterior curved tooth which is a development from the valve margin, and a narrow ridge connecting these terminal dental areas. The connecting ridge, which is an expression of the valve margin, passes without noticeable interruption into the posterior tooth. Hinge structure of left valve and other internal features not observed.

Dimensions of holotype, a separated right valve: length 1.05 mm., height 0.59 mm.

Relationships. In its general shape and in the character of its hinge this species is comparable to *C.? jacksonensis* Howe and Pyeatt occurring in beds of Jackson and Vicksburg age in Louisiana, Mississippi and Alabama. The new species is unique in its finely spinose surface and in details of its right posterior hinge tooth.

Occurrence. Ocala limestone; well no. 51, Okeechobie well, Okeechobie Co., Florida, 730 feet.

Holotype: U. S. Nat. Mus. 103778; paratypes: U. S. Nat. Mus. 103779.

Genus LEGUMINOCYTHEREIS Howe, 1936

LEGUMINOCYTHEREIS? APPLINORUM Swain, n. sp.
Plate 54, figures 11a–e; plate 55, figures 10a–b

Shell subquadrate in side view; dorsal margin nearly straight; ventral margin somewhat concave to sinuate along its middle portion; anterior end broadly rounded, slightly extended below, and somewhat compressed as seen in dorsal view; posterior end more narrowly, but rather uniformly, rounded, in some specimens slightly more extended above; greatest height slightly less than one-fifth distance from anterior end; greatest length about median, slightly oblique; greatest thickness about median. Valves about equal in size, the left scarcely larger than the right.

Eye tubercles present at antero-cardinal angles; as seen in dorsal view the tubercles are elongate parallel to dorsal margin; short, oblique sulci bound tubercles posteriorly. A narrow marginal rim extends around entire periphery of each valve, but is best developed on anterior end. As seen in dorsal view, a small elongate depression lies on marginal rim of left valve, between eye tubercles. A large, but not greatly elevated, swollen area extending from the dorsal margin almost to the ventral margin lies just posterior to the middle of each valve. A number of low, widely spaced, longitudinal ridges lie on surface of swelling, and in some specimens extend onto adjacent parts of the valve.

Hingement and other internal features not known, owing to condition of preservation.

Dimensions of holotype: length 1.08 mm., height 0.64 mm., thickness 0.54 mm.

Relationships. In the outline and nature of surface ornamentation, this species appears to agree with *Leguminocythereis* Howe, but knowledge of internal characters is lacking.

The weak pattern of ridges forming the surface ornamentation separates this from other described species.

Occurrence. Avon Park limestone, drainage well no. 16, Florida Geol. Surv. well No. 92, Orange Co., Florida, 220–40 feet.

Holotype: U. S. Nat. Mus. 103780; paratypes: U. S. Nat. Mus. 103781.

LEGUMINOCYTHEREIS? CORRUGATA
Swain, n. sp.
Plate 54, figures 14a–c; Plate 55, figures 5a–b

Shell subquadrate in side view; dorsal margin nearly straight; ventral margin slightly concave along its middle portion; anterior end broadly rounded, somewhat extended below; posterior end more narrowly and fairly uniformly rounded. Greatest height about one-fourth distance from anterior end, at antero-cardinal angle; greatest length slightly sub-median; greatest thickness median to somewhat post-median. Valves about equal in size, the left slightly larger.

Eye tubercles present at the high antero-cardinal angles are bounded behind by short, rather deep, oblique sulci. Surface ornamented with heavy ridges, which, behind the antero-cardinal angle, are arranged roughly parallel to the dorso-ventral margins, becoming weak and obscure in posterior one-fourth. In front of antero-cardinal angle, are two or three ridges which lie parallel to anterior margin. Surfaces of valves swollen medially so that in edge view the anterior and posterior ends appear to be somewhat compressed.

Hingement and other internal features not observed, owing to condition of preservation.

Dimensions of holotype: length 1.20 mm., height 0.40 mm., thickness 0.62 mm.

Relationships. This species is close to *Leguminocythereis cookei* Howe and Law, from the Oligocene Byram formation of Mississippi, but the latter has a more pointed posterior end, a prominent median muscular callosity on the exterior, and a faintly reticulate pattern of ornamentation.

Occurrence. Lake City limestone, Lake City well, Columbia County, Florida, 720–30 feet.

Holotype: U. S. Nat. Mus. 103782; paratypes U. S. Nat. Mus. 103783.

Genus CYTHERIDEA Bosquet, 1852
CYTHERIDEA (HAPLOCYTHERIDEA) BLANPIEDI Stephenson, 1936
Plate 54, figures 6a–c; plate 55, figure 6

A number of specimens thought to belong to this species are present in the collection from the Oligocene, well 4 miles east of Wauchula Post Office, Hardee County, Florida, at 470 feet.

These specimens appear to lack the characteristic short spines on the ventral half of the anterior end, but this may be the result of imperfect preservation. One specimen has three or four short spines at the posterior end, a characteristic of the species, but the other specimens do not have these spines preserved. A narrow, shallow dorso-median vertical groove or sulcus occurs just anterior to the valve middle.

Hinge structure of left valve, as seen in one separated valve, consists of terminal, elongate, notched sockets connected by a narrow groove. Owing to imperfect preservation it could not be determined whether or not the groove is crenulate, as is characteristic of the species.

U. S. Nat. Mus. 103784.

CYTHERIDEA? sp.
Plate 54, figure 13; plate 55, figure 7

Shell subovate; dorsal margin strongly convex; ventral margin nearly straight to slightly convex; anterior end broadly and uniformly rounded; posterior end narrowly rounded, extended below; greatest height about one-third from anterior end; greatest length oblique. Surface finely pitted. Internal features unknown. Shell thick.

Dimensions of figured specimen: length 0.71 mm., height 0.40 mm., thickness 0.37 mm.

Relationships. This form, which is represented in the collection by one poorly preserved specimen, has the same general shape as *C. blanpiedi* Stephenson but has a straighter ventral margin, a more finely pitted surface and appears to lack a dorso-

median sulcus. At present this is insufficient basis for recognizing a new species.

Occurrence. Cedar Keys limestone, Van Horne and Gritchlow well, one mile north of Polk City, Florida, 2750 feet.

U. S. Nat. Mus. 103785.

Genus CYTHERETTA Mueller, 1894
CYTHERETTA HOWEI Swain, n. sp.
Plate 54, figure 12; plate 55, figures 8a–c

Shell subovate in side view; dorsal margin nearly straight for most of its length, passing uniformly into the anterior end but rather abruptly into the posterior end; ventral margin gently convex; anterior end broadly rounded, extended below; posterior end narrowly rounded. An ill-defined swollen area occupies middle portion of valve. Valves appear to be equal in size. Greatest height median; greatest length about median, oblique; greatest thickness about one-fourth distance from posterior end.

Surface ornamented with a reticulate pattern, the stronger elements of the reticulum being arranged roughly parallel to the shell margins. Shell wall thick.

Hinge of a dorsally imperfect left valve consists of the following elements: an anterior rounded socket bounded in front by a small subvertically elongate tooth and behind by second small ventrally projecting tooth; a terminal posterior socket, not clearly defined owing to state of preservation, the connection between these terminal dental areas being formed by the ridgelike edge of the valve. Details of hinge of right valve not known. A nearly complete carapace, viewed dorsally shows that, at the ends of the hinge, the left valve projects into the right, in a spur-like fashion.

Muscle scar is slightly anterior and dorsal to valve middle. It consists of a horizontally elongate spot bounded below by two smaller rounded spots, and above by two small spots, the posterior of which is somewhat separated from the other. Two small, separated spots lie anterior to the main group.

Dimensions of holotype: length 1.02 mm., height 0.62 mm. This is a complete shell, but the right valve is imperfect.

Relationships. The general shape of this species, together with the structure of its hinge, indicate that it belongs to *Cytheretta*. Its reticulate surface ornamentation furnishes basis for separating it from other described members of the genus.

Occurrence. Oligocene; well four miles east of Wauchula Post Office, Hardee County, Florida, 592 feet.

Holotype: U. S. Nat. Mus. 103786; paratypes: U. S. Nat. Mus. 103787.

CYTHERETTA? DAYTONAENSIS Swain, n. sp.
Plate 54, figures 15a-b, plate 55, figures 9 a-c

Shell elongate-oval in side view; dorsal margin moderately convex; ventral margin slightly convex; valves nearly equal-ended; left valve larger than right, strongly extended beyond the right along the ventrum, less strongly at the ends, and scarcely projecting above dorsal margin of right as seen in right valve view. Greatest height about median, greatest length median; greatest thickness posterior to middle. As seen in edge view, posterior one-sixth of valves somewhat compressed. Surface ornamented with low ridges roughly parallel to shell length, and tending to be gathered near the posterior end.

Hinge of left valve consists of a terminal anterior deep socket with postjacent tooth, a terminal posterior smaller elongate socket, the connection between the two terminal areas being formed by the ridge-like edge of the valve. Hinge of right valve not known. In a complete example, viewed dorsally, the left valve projects in spur-like fashion into the right at the anterior end of the hinge, but at the posterior end the right valve sends a short spur-like projection into the left valve.

Muscle scar lies anterior to and above valve middle. It consists of four small spots arranged in a group on a small circular callosity. Other features of internal structure not observed, owing to condition of preservation.

Dimensions of holotype: length 1.10 mm., height 0.54 mm., thickness 0.51 mm.

Relationships. This species is close to *C. alexanderi* Howe and Chambers, from the Eocene Jackson formation of Louisiana. The new species differs, however, in that it has a less narrowly rounded and nondenticulate posterior end, less dorsad projection of the

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left valve above the right, and at the posterior end of the hinge the right valve projects into the left.

Occurrence. Lower part of Ocala limestone; well at Daytona Beach, Volusia County, Florida, 135–160 feet.

Holotype: U. S. Nat. Mus. 103788; paratypes: U. S. Nat. Mus. 103789.

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EXPLANATION OF PLATE 54

FIG. *1*—*Bairdia wauchulensis* Swain, n. sp. *1a–d*, Right valve views; *1c* is the holotype. All from Oligocene, well four miles east of Wauchula post office, Hardee County, Florida, at 470 feet. ×23. (p. 375)

2—*Bairdia* sp. aff. *B. woodwardensis* Howe and Law. *2a–b*, Right valve views of two specimens from Avon Park limestone, Florida Geol. Surv. well no. W 594, Seminole County, Florida, at 105 feet. ×23. (p. 376)

3—*Cytherella* sp. a. *3a–b*, Exterior views of right and left valves from Ocala limestone, well at Babson Park, Polk County, Florida, at 105 feet. ×35. (p. 375)

4—*Bythocypris? gibsonensis* Howe and Chambers. *4a–b*, Exterior views of two separated left valves from Ocala limestone, well at Eau Gallie, Brevard County, Florida, at 300 feet. ×30. *4c–d*, Right valve views of two relatively large specimens. *4e*, Interior view, looking toward posterior end of a shell broken transversely, showing the nature of the inner lamellae. *4c–e* from Avon Park limestone, well at Sanford, Seminole County, Florida, at 105 feet. *4c–d*, ×23. *4e*, ×30. (p. 375)

5—*Cythereis* aff. *C. sculptilis* Alexander. Left valve view of poorly preserved specimen from Cedar Keys limestone, Van Horne and Gritchlow well, one mile north of Polk City, Florida, at 2570 feet. ×33. (p. 377)

6—*Cytheridea* (*Haplocytheridea*) *blanpiedi* Stephenson. *6a–c*, Right valve views of three specimens from the Oligocene, well four miles east of Wauchula post office, Hardee County, Florida, at 470 feet. ×35. (p. 379)

7—*Cythereis bicarinata* Swain, n. sp. *7a, b, d*, Views of two left valves and a right valve. *7c*, holotype. *7a, c, d*, from Ocala limestone, well at Babson Park, Polk County, Florida, at 320–30 feet. *7b*, from lower Ocala limestone, Daytona Beach well, Volusia County, Florida, at 135–160 feet. All ×37. (p. 376)

8—*Cythereis parexanthemata* Swain, n. sp. *8a*, Left valve view of paratype; *8b*, right valve view of holotype. Lower Ocala limestone, Florida Geol. Surv. well. no. 239, Lake County, Florida, at 160–172 feet. ×33. (p. 377)

9—*Cythereis chinsegutensis* Swain, n. sp. *9a*, Left valve view of paratype; *9b*, right valve view of holotype. Avon Park limestone, Chinsegut Hill well, Hermando County, Florida at 390 feet. ×35. (p. 377)

10—*Cythereis? okeechobiensis* Swain, n. sp. *10a–b*, Right valve views of holotype, a separated valve, and a paratype, respectively. Ocala limestone, Florida Geol. Surv. well no. W 51, Okeechobie well, Okeechobie County, Florida, at 730 feet. ×30. (p 378)

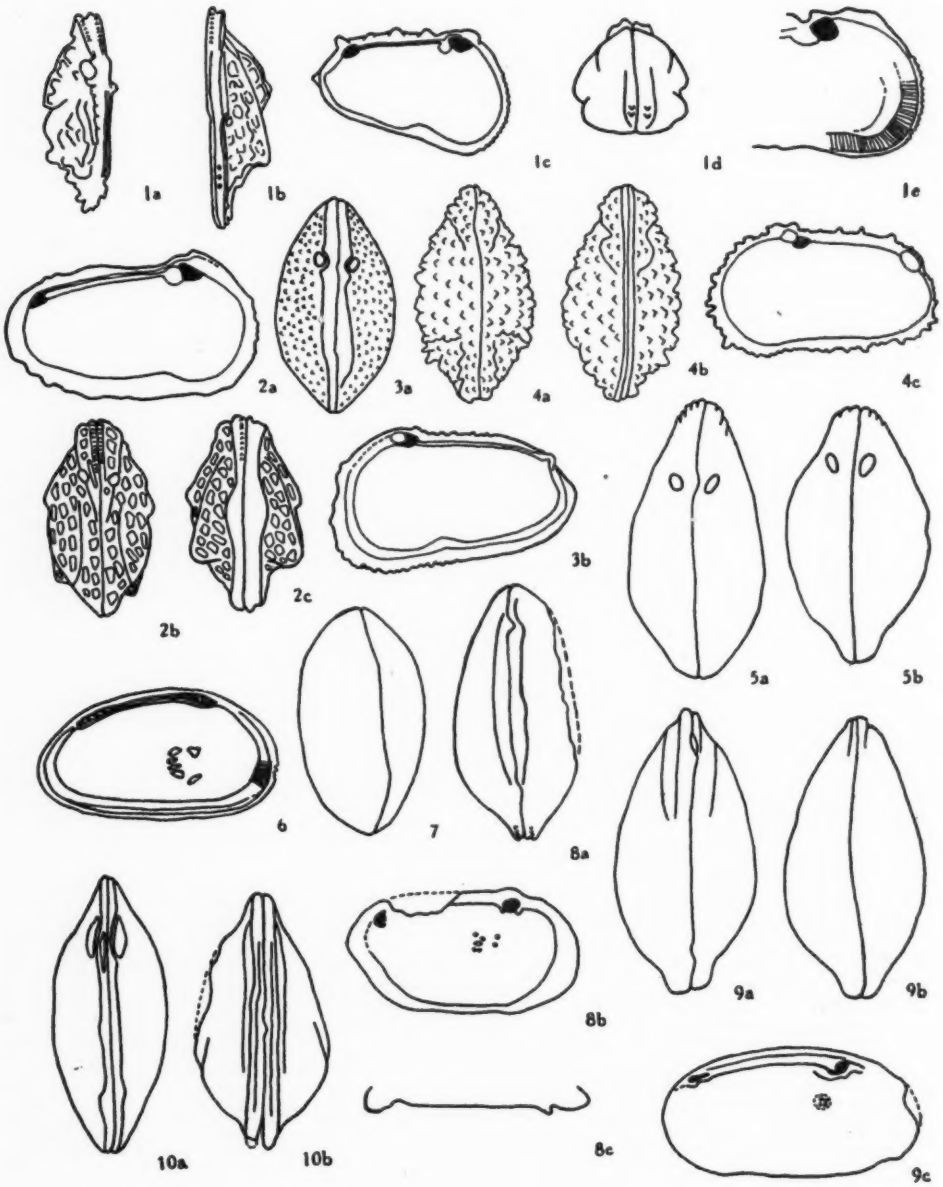
11—*Leguminocythereis? applinorum* Swain, n. sp. *11a–b*, Right and left valve views of paratypes. *11c–d*, Left valve dorsal views of holotype, possibly a male. *11e*, Ventral view of a paratype, possibly a female. All from Avon Park limestone, Florida Geol. Surv. Sell no. W 92, Orange County, Florida, at 220–40 feet. ×33. (p. 378)

12—*Cytheretta howei* Swain, n. sp. Left valve view of holotype. Oligocene, well four miles east of Wauchula post office, Hardee County, Florida, at 592 feet. ×30. (p. 380)

13—*Cytheridea* sp. Right valve view of a specimen from Cedar Keys limestone, Van Horne and Gritchlow well, one mile west of Polk City, Florida, at 2570 feet. ×33. (p. 379)

14—*Leguminocythereis? corrugata* Swain, n. sp. *14a*, Left valve view of holotype, possibly a male. *14b–c*, Right and left valve views of paratypes, possibly females, as they are relatively shorter and more tumid than the holotype. Lake City limestone, well at Lake City, Columbia County, Florida, at 720–30 feet. ×29. (p. 379)

15—*Cytheretta? daytonaensis* Swain, n. sp. *15a*, Right valve view of holotype. *15b*, Left valve view of paratype. Lower Ocala limestone, well at Daytona Beach, Volusia County, Florida, at 135–60 feet. ×27. (p. 380)



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EXPLANATION OF PLATE 55

FIG. *1—Cythereis bicarinata* Swain, n. sp. *1a* and *c*, Dorsal and interior views of a left valve paratype. *1b*, Ventral view of a left valve paratype. *1d*, Posterior view of a paratype. *1e*, Interior view of anterior end of a left valve paratype by transmitted light, showing inner margin, line of concrescence and marginal pore canals. Ocala limestone, well at Babson Park, Polk County, Florida, at 320–30 feet. *1a–d*, ×37. *1e*, ×44. (p. 376)

2—Cythereis chinsegutensis Swain, n. sp. *2a*, Interior view of a left valve paratype. ×33. *2b–c*, Dorsal and ventral views of holotype. ×27. Avon Park limestone, Chinsegut Hill well, Hermando County, Florida, at 390 feet. (p. 377)

3—Cythereis? okeechobiensis Swain, n. sp. *3a*, Dorsal view of a paratype. *3b*, Interior view of a right valve paratype. Ocala limestone, Florida Geol. Surv. well no. 51, Okeechobie County, Florida, at 730 feet. ×30. (p. 378)

4—Cythereis parexanthemata Swain, n. sp. *4a–b*, Dorsal and ventral views of holotype. *4c*, Interior view of a right valve paratype. Lower Ocala limestone, Florida Geol. Surv. well. no. W 239, Lake County, Florida, at 160–172 feet, ×37. (p. 377)

5—Leguminocythereis? corrugata Swain, n. sp. *5a*, Dorsal view of holotype, possibly a male. *5b*, Dorsal view of a paratype, possibly a female. Lake City limestone, well at Lake City, Columbia County, Florida, at 720–30 feet. ×32. (p. 379)

6—Cytheridea (*Haplocytheridea*) *blanpiedi* Stephenson. Interior view of a left valve from the Oligocene, well four miles east of Wauchula post office, Hardee County, Florida, at 470 feet. ×40. (p. 379)

7—Cytheridea sp. Dorsal view of a specimen from the Cedar Keys limestone, Van Horne and Gritchlow well, one mile west of Polk City, Florida, at 2570 feet. ×42. (p. 379)

8—Cytheretta howei Swain, n. sp. *8a*, Dorsal view of holotype. *8b–c*, Interior and dorsal views of an imperfect left valve paratype. Oligocene, well four miles east of Wauchula post office, Hardee County, Florida, at 592 feet. ×33. (p. 380)

9—Cytheretta? daytonaensis Swain, n. sp. *9a–b*, Dorsal and ventral views of holotype. *9c*, Interior view of a left valve paratype. Lower Ocala limestone, well at Daytona Beach, Volusia County, Florida, at 135–170 feet. ×40. (p. 380)

10—Leguminocythereis? applinorum Swain, n. sp. *10a*, Dorsal view of holotype, possibly a male. *10b*, Ventral view of a paratype which is relatively more tumid posteriorly than the holotype, possibly a female. Avon Park limestone, Florida Geol. Surv. well no. W. 92, Orange County, Florida, at 220–40 feet. ×37. (p. 378)

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ALLEGHENY FOSSIL INVERTEBRATES FROM EASTERN OHIO—AMMONOIDEA

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ABSTRACT—Six ammonoids are illustrated and described from the Vanport and Hamden members of the mid-portion of the Allegheny formation of eastern Ohio. These are referable to the genera *Gonioglyphioceras*, *Eoasianites*, *Neoshumardites*, and *Wellerites;* and it is concluded that the beds which yielded them are of about the same age as the Wewoka formation and the Buckhorn asphalt of Oklahoma and the Millsap Lake formation of Texas.

AMONOIDS are rare in the Pennsylvanian strata of Ohio. Their occurrence there was recorded well over a century ago, but only one or two additional specimens have since been mentioned in the literature. Furthermore, all the forms that have been recorded thus far seem to have come from the Conemaugh formation, and none has been even listed from the Pottsville, Allegheny, or Monongahela formations of Ohio, Pennsylvania, or West Virginia.

For some years the junior author has periodically been studying the Pennsylvanian of Ohio, particularly the Allegheny formation, and during this work he has collected a few ammonoids, which constitute the basis for this report. Most of these specimens are neither well preserved nor very complete, but nevertheless the generic affinities of all of them can be determined.

Altogether six ammonoids have now been obtained from the Allegheny formation. Three of these came from the Vanport limestone and three from the Hamden limestone. Stratigraphically these two members are only some 25 feet apart, and there seems to be every reason to believe that they are not greatly different in age. The specimens from the Vanport are referable to the genera *Eoasianities*, *Neoshumardites*, and *Wellerites*, and those from the Hamden to *Gonioglyphioceras*, *Eoasianites*, and *Wellerites*. Both *Eoasianites* and *Neoshumardites* have a long rage in the Late Paleozoic, but *Gonioglyphioceras* and particularly *Wellerites* seem to be limited to a rather narrow stratigraphic zone. Both of these latter genera occur in the rich ammonoid fauna of the Wewoka formation of east-central Oklahoma, the Buckhorn asphalt (near Sulphur) in south-central Oklahoma, and the Millsap Lake formation (Strawn) of north-central Texas. Almost certainly their age is not greatly different in all four of these localities.

Long ago Morton (1836, pp. 40, 137, 149, 154; pl. 1, fig. 24; pl. 28, figs. 48–50, 51?, 53, 54) illustrated and described five or six goniatites from Ohio. One of them came from near the type section of the Cambridge limestone (Conemaugh). The others are from near the bottom of a 150-foot shaft at "Junior Furnace" in Scioto County, close to the Ohio River. Dr. Wilber Stout has written us that this charcoal blast furnace was located "very close to the base of the Pottsville formation." Therefore the goniatite-bearing beds at this locality are almost certainly Mississippian in age. Morton's illustrations of the specimens are crude woodcuts, and his descriptions are so brief and generalized that they are of little help in modern paleontological investigations. Accordingly, unless the specimens from the shaft at "Junior Furnace" can be found and restudied, which is very unlikely, it is extremely doubtful if their affinities can ever be determined. The specimen Morton illustrated from the Cambridge limestone is the only one of the syntypes of *Schistoceras hildrethi* (Morton) of which the generic affinities can be recognized, and it may well be the same individual that was later well illustrated and described by Haug (1898, pp. 33, 105–107, pl. 1, figs. 40a–40c). Recently Miller and Unklesbay (1942, pp. 155–158, pl. 8, figs. 4, 5) have recorded the discovery of a well preserved representative of

Schistoceras missouriense (Miller and Faber) in the Cambridge limestone near New Concord, Ohio. In so far as we have been able to ascertain, no other ammonoids are known from the Pennsylvanian of Ohio.

SYSTEMATIC DESCRIPTIONS

GONIOGLYPHIOCERAS sp.
Plate 56, figures 4, 5

The Allegheny formation of Ohio has yielded an internal mold of part of a mature volution of a phragmacone that seems to be closely similar to the genotype of *Gonioglyphioceras*. The lateral zones of this specimen are flattened (though very broadly convex) and the ventral zone is acute. Near the mid-length of the specimen the height and width of conch measure about 36 mm. and 14 mm., respectively. The umbilicus appears to have been small. No trace of surface markings of the test is discernible.

Each external suture forms a very large bifid ventral lobe (the prongs of which are rather short and V-shaped but narrowly rounded) and on either side of it a large broad asymmetrical rather narrowly rounded first lateral saddle, a relatively small rather narrowly rounded lateral lobe, and a low broad rounded asymmetrical second lateral saddle that extends to the umbilicus.

Remarks.—The specimen under consideration resembles very closely *Gonioglyphioceras gracile* (Girty) of the Wewoka formation of Oklahoma. However, the first lateral saddles of its sutures, and to a lesser extent the prongs of the ventral lobe, are more broadly rounded. Since *G. gracile* is the genotype of *Gonioglyphioceras*, we are referring our specimen to that genus. One of the most diagnostic features of the genus is stated by Plummer and Scott to be a retuse venter, but in part of the Wewoka specimens in our collections the ventral furrow is largely, if not entirely, confined to the test, and not more than a trace of it is retained on the internal mold.

Occurrence.—Hamden limestone in the Brookwood mine, west-central part of section 29, Perry Township, Columbiana County, Ohio.

Repository.—Ohio State Univ., 18734.

EOASIANITES cf. E. GLOBULOSUS
(Meek and Worthen)
Plate 56, figures 1–3, 10, 11

(?) *Goniatites globulosus* Meek and Worthen, 1860, Acad. Nat. Sci. Philadelphia, Proc. 1860, p. 471.
(?) *Goniatites globulosus* Meek and Worthen, 1866, Illinois Geol. Surv., vol. 2, pp. 390–392, pl. 30, figs. 2a–2c.
(?) *Gastrioceras globulosum* Hyatt, 1884, Boston Soc. Nat. Hist., Proc., vol. 22, p. 327.
(?) *Goniatites globulosus* Smith, 1894, Jour. Geol., vol. 2, p. 191.
(?) *Gastrioceras globulosum* Smith, 1896, Amer. Phil. Soc., Proc., vol. 35, pp. 258–260, pl. 18, figs. 1–6.
(?) *Gastrioceras globulosum* Smith, 1897, Leland Stanford Junior Univ. Publ., Contr. Biol. from Hopkins Seaside Lab., no. 9, pp. 48–50, pl. 18, figs. 1–6.
(?) *Glyphioceras globulosum* Haug, 1898, Soc. géol. France, Mém., Paléont., t. 7, no. 18, p. 26.
(?) *Gastrioceras globulosum* Smith, 1903, U. S. Geol. Surv., Mon. 42, pp. 89–90, pl. 6, fig. 1; pl. 21, figs. 7–9.
(?) *Glaphyrites globulosus* Plummer and Scott, 1937, Texas Univ., Bull. 3701, pp. 276–279, pl. 15, figs. 1–8.

We have two Allegheny specimens that clearly belong in the genus *Eoasianites* as now interpreted (see Miller and Furnish, 1940, pp. 77–78). One of them (pl. 56, figs. 10, 11) is from the Vanport limestone. This specimen, part of which is crushed and distorted, is septate throughout. It attains a maximum diameter of about 30 mm., and near its adoral end its conch is about 7 mm. high and 28 mm. (estimated) wide. The whorls are very broadly rounded ventrally. The umbilical shoulders are subangular, and the umbilical walls are rather strongly converged dorsad. The umbilicus of this specimen is large, and it attains a maximum diameter of about 19 mm. On the outer volution, each suture forms a broad prominently bifid ventral lobe (the prongs of which are pointed-spatulate) and on either side of it a high fairly broad U-shaped rounded first lateral saddle, a rather broad deep pointed-spatulate first lateral lobe, a broad rounded asymmetrical second lateral saddle, and a low acuminate lobe on the umbilical wall.

The specimen represented by figures 1–3 on plate 56 is from the Hamden limestone. In general physiognomy it resembles the Vanport specimen just described, but its

umbilical shoulders are narrowly rounded rather than subangular. The maximum diameter attained by the figured portion of this specimen (which also is septate throughout) measures about 27 mm.; and near its adoral end its conch is about 6½ mm. high and about 22 mm. (estimated) wide, and the maximum diameter attained by its umbilicus measures about 15 mm. An unfigured fragment that adhered to this specimen shows that the phragmacone extended at least half a volution farther orad. As shown by text figure 1, each suture of this specimen forms a deep bifid ventral lobe (the

FIG. 1—Diagrammatic representation of a suture of *Eoasianites* cf. *E. globulosus* (Meek and Worthen), ×2. Based on the adoral portion of the outer volution of the specimen represented by figures 1–3 on plate 56, where the conch is about 26 mm. in diameter.

adoral portion of which is considerably contracted) and on either side of it a high rounded spatulate first lateral saddle, a deep hastate first lateral lobe, a broad rounded asymmetrical second lateral saddle, a low acuminate lobe on the umbilical wall, a broad rounded asymmetrical internal second lateral saddle, a hastate internal first lateral lobe, and a high rounded spatulate internal first lateral saddle that extends to the deep hastate dorsal lobe.

Remarks.—The sutures of the two specimens under consideration are in general similar, but certain differences are readily apparent, particularly in the details of the ventral and lateral lobes. Also, as mentioned above, the umbilical shoulders of these two individuals are not alike. The sutures of the Vanport specimen are strikingly similar to those of a specimen from the Graham shale (Cisco) of Texas figured by Plummer and Scott (1937, pl. 15, fig. 7) and referred to Meek and Worthen's species. However, they do not appear to resemble very closely those of the holotype of *E. globulosus* (Meek and Worthen), which came from near Springfield, Illinois. Also, the holotype has a relatively small umbilicus, and its conch is rapidly expanded orad. The taxonomic value of such differences is, of course, a matter of opinion, but we are inclined to doubt that both of our Allegheny specimens belong in the same species, and that either of them is conspecific with the holotype of *E. globulosus* or with the Kansas, Arkansas, and Texas specimens that have been referred to that species, probably erroneously.

Occurrence.—Vanport limestone in a small abandoned strip mine about 2½ miles west of Canfield, Mahoning County, Ohio (found by E. L. Stephenson); and Hamden limestone in the abandoned Buzzard mine, north-central part of section 3, Salem Township, Columbiana County, Ohio.

Repository.—Ohio State Univ., 18735 (Vanport specimen) and 18736 (Hamden specimen).

NEOSHUMARDITES sp.
Plate 56, figure 12

The collection under consideration contains a single representative of the rather rare genus *Neoshumardites*. This specimen is crushed and fragmentary, but it elucidates the nature of both the external and the internal sutures (about half a volution apart). Precise measurements of this specimen are clearly of little significance, but it should perhaps be stated that it attains a maximum diameter of about 26 mm. (in its present crushed and incomplete state). The shape of the whorls can not be ascertained, but there appears to be no good reason to suspect that they differ materially from those of other congeneric forms. The umbilicus is large, and that of the specimen we are studying attains a maximum diameter of about 11 mm. The umbilical shoulders are abruptly rounded, and the umbilical walls are very steep. No trace of surface markings of the test is discernible.

Each external suture forms a large broad prominently bifid ventral lobe (the prongs of which are asymmetrical and incipiently bifid) and on either side of it a high undivided more or less spatulate first lateral saddle, a large broad unequally trifid slightly asymmetrical lateral lobe, a broad rounded very asymmetrical second lateral saddle, a small subangular lobe on the um-

bilical wall, a broad shallow broadly rounded asymmetrical internal second lateral saddle, a large prominent unequally trifid internal lateral lobe, and a deep, undivided, more or less spatulate, internal first lateral saddle which extends to the deep unequally but symmetrically trifid dorsal lobe.

Remarks.—The genus *Neoshumardites* was established by Ruzhencev (1936, pp. 1083, 1084–1085, 1088), who based it on two Russian Permian species, *N. triceps* Ruzhencev of the Artinskian (genotype), and *N. sakmarae* Ruzhencev of the Sakmarian. Later, Miller and Furnish (1940, p. 77) recognized the validity of the genus and stated that we should probably refer to it such American Pennsylvanian forms as *Shumardites cuyleri* Plummer and Scott of the Cisco of Texas and *Preshumardites stainbrooki* Plummer and Scott of the Canyon of the same state. The Allegheny specimen we are studying is believed to be the oldest known representative of the genus, and it extends the range well down in the Pennsylvanian. As shown by our text figure 2, both the external and the internal sutures of this Allegheny form are in general (but not in detail) similar to those of the genotype and *N. cuyleri.* This specimen undoubtedly represents an unnamed species, but we refrain from proposing a name for it because of its unsatisfactory nature.

Occurrence.—Vanport limestone in the abandoned Nick Weingart mine, east-central part of section 7, Green Township, Mahoning County, Ohio.

Repository.—Ohio State Univ., 18737.

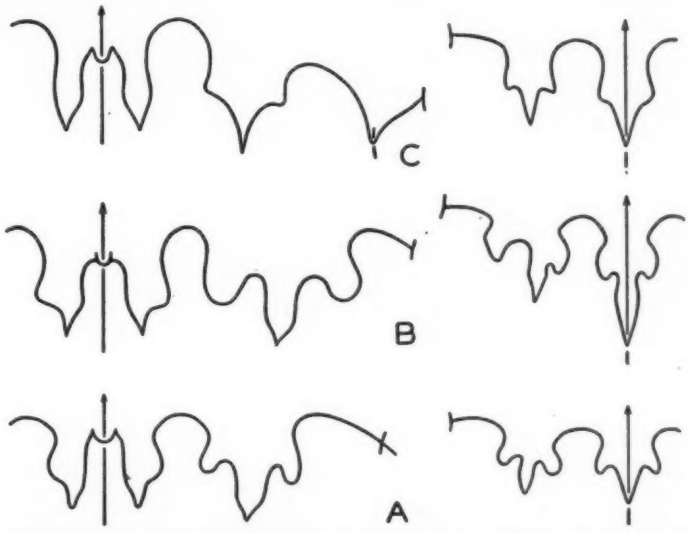


FIG. 2—Diagrammatic representations of both the external and the internal sutures of three species of *Neoshumardites:* (**A**) *N.* sp. from the Allegheny of Ohio, ×4 (external suture) and ×2¼ (internal suture); (**B**) *N. cuyleri* (Plummer and Scott) from the Cisco of Texas, ×1¾ (adapted from Plummer and Scott); and (**C**) *N. triceps* Ruzhencev from the Artinskian of Soviet Russia, ×3 (adapted from Ruzhencev).

WELLERITES sp.
Plate 56, figures 6–9

The Hamden limestone has yielded a poorly preserved somewhat crushed fragment of an ammonoid that fortunately shows the shape of the cross section of the conch and the general nature of the external suture (pl. 56, figs. 6, 7). The conch is subrectangular in cross section as its lateral zones are essentially flat and parallel, its ventral zone is very broadly rounded, and its dorsal zone is rather deeply impressed. The umbilical shoulders are abruptly rounded, and the umbilical walls are very steep, being essentially normal to the flattened lateral zones of the conch. The height

of conch of the preserved part of the specimen measures some 25 mm. and the width some 16 or 17 mm. The general shape of the suture of this specimen is shown by text figure 3B, but it should be emphasized that the details of the shape of the components of the suture can not be ascertained.

Also we have a small specimen from the Vanport limestone that presumably belongs in this genus, though it shows only the internal sutures (pl. 56, figs. 8, 9). This specimen is subdiscoidal or sublenticular in shape. It is about 19 mm. in diameter and its maximum width measures only about 5

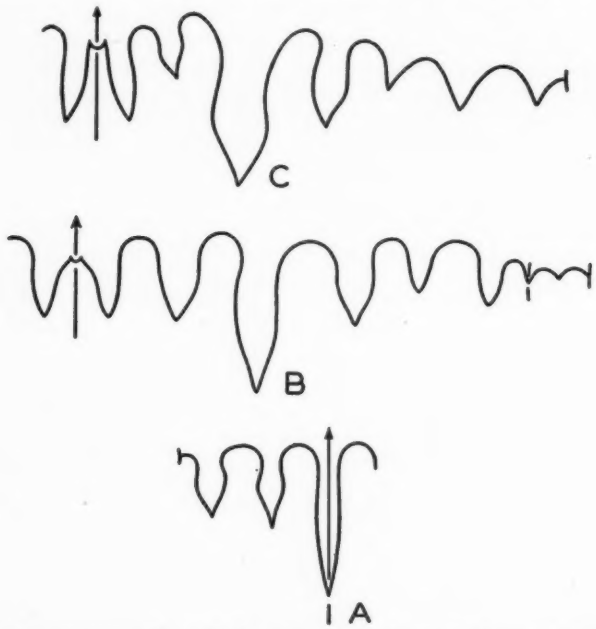


FIG. 3—Diagrammatic representations of the sutures of three specimens belonging in the genus *Wellerites:* (**A**) *W.* sp. from the Vanport limestone of Ohio, ×4 (internal sutures); (**B**) *W.* sp. from the Hamden limestone of Ohio, ×2 (external sutures); and (**C**) *W. mohri* Plummer and Scott from the Strawn of Texas, ×5 (external sutures)—**A** is based on the specimen represented by figures 8, 9 on plate 56, at a diameter of about 15 mm.; **B** on the specimen represented by figures 6, 7 on the same plate; and **C** is adapted from Plummer and Scott.

EXPLANATION OF PLATE 56

All specimens illustrated on this plate are from the Allegheny formation of eastern Ohio, and they are deposited in the Geological Museum of Ohio State University. The figures, which are all ×1½, are photographs retouched by Lee and Mary Allen.

FIGS. *1–3—Eoasianites* cf. *E. globulosus* (Meek and Worthen) from the Hamden limestone in section 3, Salem Township, Columbiana County, Ohio—figure 2 is a dorsal view of the adoral portion of the specimen. (p. 385)

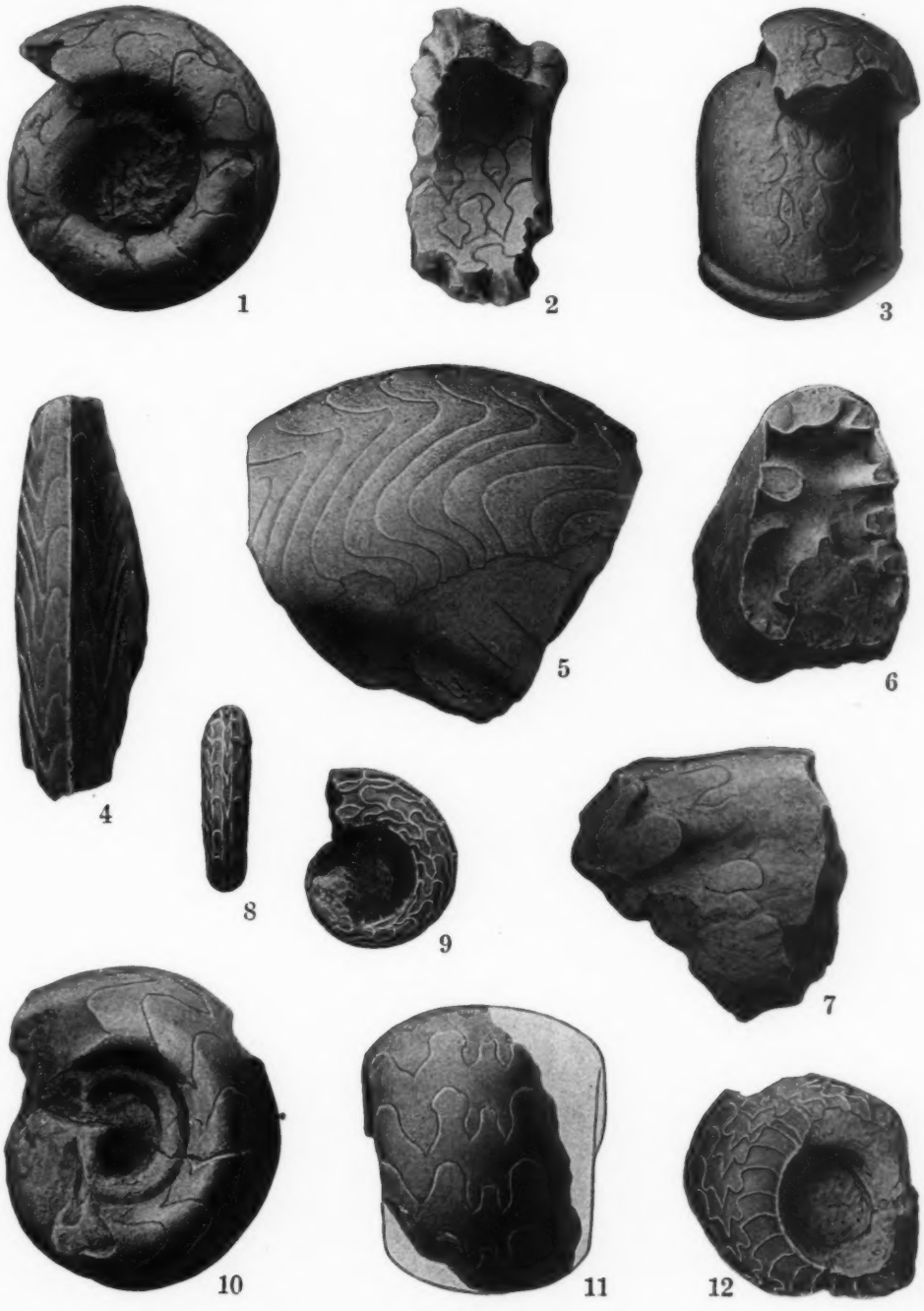
4, 5—Gonioglyphioceras sp. from the Hamden limestone in section 29, Perry Township, Columbiana County, Ohio. (p. 385)

6, 7—Wellerites sp. from the Hamden limestone in section 29, Perry Township, Columbiana County, Ohio. (p. 387)

8, 9—Wellerites sp. from the Vanport limestone in section 7, Green Township, Mahoning County, Ohio. (p. 387)

10, 11—Eoasianites cf. *E. globulosus* (Meek and Worthen) from the Vanport limestone west of Canfield, Mahoning County, Ohio. (p. 385)

12—Neoshumardites sp. from the Vanport limestone in section 7, Green Township, Mahoning County, Ohio. (p. 386)



Miller and Sturgeon – Pennsylvanian Ammonoidea

mm. Apparently the umbilicus of this specimen is rather large. The shape of the internal sutures is shown by text figure 3A, and it should be noted that the dorsal lobe is particularly deep.

Remarks.—Neither of the above-described specimens is any too satisfactory, for the one from the Hamden limestone is not well preserved or very complete and the Vanport specimen does not show the nature of the external sutures. Nevertheless, it seems reasonably certain that both belong in the genus *Wellerites*. They may or may not be conspecific.

In general these two Allegheny specimens are similar to representatives of *Wellerites* in our collections from the Millsap Lake formation of Texas, the Wewoka formation of Oklahoma, and the Buckhorn asphalt of the same state (near Sulphur). However, they are almost certainly not conspecific with any of them and presumably represent an unnamed species, but neither would make a satisfactory holotype.

Occurrence.—Vanport limestone in the abandoned Nick Weingart mine, east-central part of section 7, Green Township, Mahoning County, Ohio (smaller specimen); and Hamden limestone in the Brookwood mine, west-central part of section 29, Perry Township, Columbiana County, Ohio (larger specimen).

Repository.—Ohio State Univ., 18738 (smaller specimen) and 18739 (larger specimen).

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JOURNAL OF PALEONTOLOGY, VOL. 20, NO. 4. PP. 390–394, JULY 1946

PALEONTOLOGICAL NOTES

CONTRIBUTIONS TO THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

The council of the S.E.P.M. initiated in October 1945 a drive for contributions to the revolving fund of the International Commission on Zoological Nomenclature. The appeal for contributions was sent out in the fall of 1945. Members and subscribers of the society responded generously to this appeal so that $349.00 were contributed. This sum was transmitted to the Secretary of the International Commission on Zoological Nomenclature in London on April 27, 1946. The following letter acknowledges this contribution:

Dear Dr. Stenzel: 3rd May 1946

The Commission's Publications Office have reported to me by telephone the receipt today of your letter 27th April enclosing a cheque for the sum of three hundred and forty-nine dollars ($349.00), being a gift to the funds of the International Commission from the members of the Society of Economic Paleontologists and Mineralogists.

The International Commission, on learning of this gift, will be most grateful to the members of the Society both for this valuable and most welcome gift and also for the interest in their work which this gift denotes. On behalf of the Executive Committee of the International Commission, I shall be grateful if you will be so kind as to express to the Council of the Society the warm thanks of the Commission for their action in organising the collection of this fund and, through the Council, to the members of the Society who have contributed to this fund.

As you are aware, the Commission possesses no endowments and has therefore to rely entirely upon gifts from scientific institutions and individual zoologists to supplement the income obtainable from the sale of their publications. Gifts such as that received from your Society are thus particularly valuable, for, by strengthening the financial position of the Commission, they not only make possible the more rapid issue of the Commission's scientific publications but also bring nearer the day when the Commission will be sufficiently strong to be able to reduce still further the scale of charges for their publications, thereby making them more readily obtainable to all interested zoologists. As I expect you are aware, these charges were cut by the large amount of 30 per cent as from 1st February this year. The Commission regard this as an important step towards the attainment of their low-price policy, in which they do not doubt they will have the full support of the zoological and paleontological professions.

I have asked the Publications Office to send to you a receipt direct for the cheque which you have so kindly sent. This gift will be announced by the International Commission in their *Bulletin of Zoological Nomenclature.*

Sincerely yours,
(signed)
Francis Hemming

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PORTERS CREEK FORAMINIFERA OF ILLINOIS—CORRECTIONS AND COMMENTS

MORTON B. STEPHENSON

A Midway (Eocene) foraminiferal fauna from a water well in southern Illinois was described in a previous issue of this JOURNAL by Doctor Chalmer L. Cooper (Cooper, 1944). The occurrence of this fauna so far north is indeed of interest, but unfortunately several technical errors appear in the work. Some of these were called to Cooper's attention in August, 1944, and he subsequently published brief errata (Cooper, 1945).

In these errata one of the corrections is in error. *Siphonogeneroides* in the original report should be *Siphogenerinoides* (6, p. 237). Also *Siphonia* should be corrected in the original report to *Siphonina*, in the list on page 347, and the explanation of plate 55, as well as on page 353 as indicated. Finally *Anomalina* is misspelled *Anomolina* although it is correct in the original report.

Four other uncorrected errors appear in the text. Page 346, column 2, read *Chrysalogonium* for *Chrysaligonium*. Page 348, column 1, line 4, read *Dentalina* for *Dentalia*. Page 351, column 1, line 45, read *Vaginulina* for *Vagulina*. Page 351, column 2, line 48, read *Siphogenerina* for *Siphonogenerina*.

Cooper stated (1944, p. 346) that

"the fauna is distinct from that in the Upper Cretaceous, which can be recognized by its preponderance of Textredariidae . . . "

(Textulariidae, later corrected). Cushman described the Upper Cretaceous Saratoga Chalk fauna of Arkansas (Cushman 1931a)

and later that of the Annona (Cushman 1932). Plummer (1931) recorded Upper Cretaceous Foraminifera from Texas, and Cushman (1931) the species present in Tennessee. These faunas contain only from 2 to 4 per cent of forms classed under the Textulariidae. Cooper (1944, p. 346) likewise stated his fauna lacked

> " . . . the frequent occurrence of many species of the Miliolidae . . . "

which characterizes the Wilcox (Eocene). None of the 48 species reported by Cushman and Ponton (1932) from the Wilcox of Alabama was classed under the Miliolidae. Toulmin described 97 species from the Salt Mountain limestone (Wilcox Eocene) of Alabama (1941), and only one species is a miliolid. Such unqualified generalizations are misleading, and are unsupported by published data on faunas from exposures in the southern portion of the Mississippi Embayment and Gulf Coastal Plain.

Cooper (1944, p. 351) stated that *Robulus midwayensis* (Plummer) is " . . . a good Midway marker in Texas." This is apparently a misinterpretation of the remarks of Mrs. Plummer in the original description, where the species was reported to occur in the Wilcox of Alabama. Regarding this species she wrote (Plummer, 1926, p. 96):

> Because marine phases of the Wilcox are very rare in Texas, it is unlikely that any ambiguity will arise in assigning Midway age to strata carrying this species in this state.

I have observed *R. midwayensis* to occur upward some distance into marine lower Wilcox strata in the subsurface section. Therefore this species is not a reliable marker for determination of the Midway age of strata.

It seems regrettable that new species were described from this Illinois material, much of which is poorly preserved and fragmentary. Presumably the specimens are preserved in the collections of the Illinois Survey, but these species will be identified by other workers only with difficulty because additional material is unobtainable. *Dentalina spira* Cooper, a new species (1944, p. 348, pl. 54, figs. 1, 2), was figured from a single chamber, undoubtedly the best and apparently the only specimen available. In my opinion, this specimen is generically and specifically indeterminable, and complete tests must be studied to place it properly. The assignment of three broken leached fragments to *Nodosaria latejugata*, *N.* cf. *vertebralis*, and *N.* cf. *zippei* is certainly questionable. The literature indicates a wide diversity of opinion as to the characters of these nodosarian forms, which have often been figured from well-preserved tests. Considering the variants of microspheric and megalospheric forms, changes in growth stages, and differing characters of various portions of the tests, these figured fragments all might represent the same species.

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——, 1940, Foraminifera their classification and economic use, Ed. 3, Harvard Univ. Press, Cambridge, Mass.

——, and PONTON, G. M., 1932, An Eocene foraminiferal fauna of Wilcox age from Alabama: Contrib. Cushman Lab. Foram. Res., vol. 8, no. 3, pp. 51–72.

PLUMMER, HELEN J., 1926, Foraminifera of the Midway formation in Texas: Univ. Texas Bull. 2644.

——, 1931, Some Cretaceous Foraminifera in Texas: *in* Univ. Texas Bull. 3101, pp. 109–203.

TOULMIN, L. D., 1941, Eocene smaller Foraminifera from the Salt Mountain limestone of Alabama: Jour. Paleontology, vol. 15, pp. 567–611.

REDUCTION IN PRICES OF ZOOLOGICAL COMMISSION PUBLICATIONS

The Joint Committee on Zoological Nomenclature for Paleontology in America has felt very strongly that the publications of the International Commission on Zoological Nomenclature (Jour. Paleont., vol. 20, p. 291 should be readily available to all paleon-

tologists. To that end it urges all paleontologists to take steps to see that the library at the institution with which they are connected purchases a sufficient number of complete sets of these publications to serve the needs of the paleontologists and zoologists working at the institution. Likewise many individuals, professional workers and students will feel that to own such a valuable series of reference works is the only means by which it will be always at hand when needed.

An obstacle to the desired more widespread distribution has been the relatively high prices that the Commission felt it was necessary to charge for its publications in order to survive financially during the difficult war years. The war is now over and consequently the sales of the Commission's publications increased in 1945 to the point where the proceeds of the sales very nearly balanced the Commission's budget for that year. Likewise considerable progress has been made in the Commission's campaign to raise a revolving publication fund, due in no small part to the splendid response of the Geological Society of America and of individual American paleontologists through the Paleontological society and the Society of Economic Paleontologists and Mineralogists. As a result of the somewhat improved financial position of the Commission, Secretary Hemming has recently announced that the scale of prices on publications issued by the Commission after January 31, 1946 is reduced 30 per cent. This is indeed good news, and it is to be hoped that it will result in a much wider distribution of the Commission's publications not only to institutional libraries but to individual workers. Wider distribution will redound to the benefit not only of the American paleontologist and American paleontology but to paleontology and zoology of the world, for with expanding distribution will come generally improved nomenclatural practice together with probable further reductions in prices and so on, a benign circle, as it were.

Inquiries and subscriptions should be addressed to the International Commission on Zoological Nomenclature, 41 Queen's Gate, London S.W. 7, England.

For the Joint Committee on Zoological Nomenclature for Paleontology in America,

J. BROOKES KNIGHT, *Chairman*

CLADOCHONUS STRIATISSIMUS EASTON, NEW NAME FOR CLADOCHONUS STRIATUS EASTON, 1944

WM. H. EASTON
University of Southern California, Los Angeles 7, California

Miss Helen Duncan of the U. S. Geological Survey has kindly called my attention to the fact that *Cladochonus striatus* Easton, 1944 (p. 62; pl. 13, fig. 5; pl. 17, figs. 4, 5) is preoccupied by *Cladochonus striatus* Hill, 1942 (p. 70; pl. 2, fig. 11).

Hill's species, from the Callythyrra series (Permian) of western Australia differs from the Chouteau (Mississippian) species in having longer corallites with wider calyces and less pronounced striae. Both species are distinguishable from other *Cladochonus* by being longitudinally striated. In view of the known differences between these corals, I propose the new name *Cladochonus striatissimus* Easton for *Cladochonus striatus* Easton, 1944.

In as much as foreign publications for recent years are not yet readily consulted, the writer is indebted to the Librarian, U. S. Geological Survey, for permission to borrow the reprint of Hill's article.

REFERENCES

EASTON, W. H., 1944, Corals from the Chouteau and Related Formations of the Mississippi Valley Region: Illinois State Geological Survey, Rept. Inv. 97.

HILL, D., 1942, Further Permian Corals from Western Australia: Royal Soc. Western Australia, Jour., vol. 27 (1940–41), pp. 57–75, pls. 1, 2. *Reprinted as* Univ. Queensland Papers, Dept. Geol., vol. 2, (n. ser.), no. 10, 1942.

PRIONIODUS? AMANAENSIS YOUNGQUIST, NEW NAME

WALTER YOUNGQUIST
State University of Iowa, Iowa City, Iowa

It has been brought to my attention by Dr. Samuel P. Ellison, Jr., that the name *Prioniodus? peculiaris* which I proposed in 1945 (JOUR. PALEONTOLOGY, vol. 19, p. 366, pl. 55, fig. 11) is preoccupied by *P. peculiaris* Branson and Mehl. The new name *Prioniodus? amanaensis* is here submitted for the Upper Devonian conodont species which I described.

REVIEWS

THE FORAMINIFERA OF THE CIPERO MARL FORMATION OF TRINIDAD, BRITISH WEST INDIES, by Joseph A. Cushman and R. M. Stainforth, Cushman Laboratory for Foraminiferal Research, Special Publication 14, 75 pp. 16 pls. 1945. $1.50.

The Cipero Marl, 2500 to 3000 feet thick, is divisible into three zones which carry different foraminiferal faunules. Zone I, characterized by *Globigerina concinna* is Lower Oligocene but may extend into the Upper Eocene below and the Middle Oligocene above. Zone II, characterized by *Flobigerinatella insueta*, is Middle to Upper Oligocene. Zone III, characterized by *Globorotalia fohsi*, is probably Upper Oligocene. All three zones consist of sediments deposited in warm water either at a considerable distance from shore or at depths of more than 30 fathoms.

The fauna consists of 257 species and varieties referred to 84 genera of which 45 species and varieties and 1 genus are new. One new specific name is proposed for a homonym and three forms have not been named or compared with described species or varieties. A chart shows the stratigraphic distribution of 60 of the more abundant forms.

J.M.W.

A RÉSUMÉ OF THE PALEOZOIC STRATIGRAPHY OF COLORADO, by J. Harlan Johnson, pp. 109, Quarterly of the Colorado School of Mines, Vol. 40, No. 3, July, 1945. $2.00.

All of the Paleozoic systems except the Silurian are represented by outcropping formations in Colorado. The pre-Pennsylvanian beds exceed 1000 feet in total thickness at few places. The Pennsylvanian and Permian together are generally over 5000 feet thick and locally attain a thickness 2 or 3 times this much.

The Cambrian is largely quartzite. The Ordovician, Devonian and Mississippian mainly consist of limestone and dolomite. The Pennsylvanian and Permian are clastic with local evaporites in the lower part, red beds above and minor limestone members.

Twenty-six formations of all ages are briefly described and local stratigraphic sections are presented illustrating the characters of many of them. Reported fossils are listed mainly from the literature, some of them by obsolete names. There are several correlation tables and charts but some of the formations recognized are not included in them and several formations names appear in them that are not described in the text.

Boundaries between the Cambrian and Ordovician and between the Pennsylvanian and Permian systems are more or less uncertain. The lower and upper boundaries of the Paleozoic rocks are not discussed except incidentally.

This report is a valuable summary of the present knowledge of Colorado's Paleozoic rocks and the footnotes and 11 page bibliography are useful guides to the literature. Obviously much of the available data were derived from more or less local and uncoordinated studies. Much work remains to be done particularly in the field of paleontology and correlation but, unfortunately, fossils are reported to be scarce or poorly preserved in many of the formations.

J.M.W.

JOURNAL OF PALEONTOLOGY, VOL. 20, NO. 4, PP. 395–400, JULY 1946

SOCIETY RECORDS AND ACTIVITIES

REPORTS AND MINUTES OF THE TWENTIETH ANNUAL MEETING OF THE SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

The twentieth annual meeting of the Society of Economic Paleontologists and Mineralogists was held in the Stevens Hotel in Chicago, Illinois, April 3–4, 1946, in conjunction with the annual meeting of The American Association of Petroleum Geologists.

The technical program of the Society, with John R. Sandidge, J. Marvin Weller, and H. B. Stenzel presiding, began at 9:00 A.M., April 3, and continued until 4:30 P.M. The following papers were presented:

Paul D. Krynine, "Development of Porosity in Reservoir Rocks"

F. J. Pettijohn, "Carbonate Inclusions in Secondary Outgrowths on Clastic Quartz in Limestone"

Ada Swineford and Frances Swineford, "Comparison of Three Sieve Shakers"

E. C. Dapples, "Some Physical Properties of Glacial Tills from Northeastern Illinois"

Horace G. Richards, "Studies on Macrofossils from Deep Wells along the Atlantic Coast"

Leroy T. Patton, "Modal Analyses of Well Cores from the Basement Complex of West Texas"

Paul D. Krynine and Ruth O. Hotton, "Sediments of the United States"

Wilbert H. Hass, "Conodont Faunas from Upper Devonian and Lower Mississippian Formations of Ohio"

Harold W. Scott, Doris Nodine, and Edward Zeller, "Wall Structure of Endothyra Baileyi"

Lloyd G. Henbest, "The Morrow Group, Pennsylvanian, of Washington County, Arkansas"

Chalmer L. Cooper, "Upper Kinkaid (Mississippian) Microfauna"

James Steele Williams, "Mississippian of Southeastern Alaska"

A. K. Miller and Walter Youngquist, "A Giant Ammonite from the Cretaceous of Montana"

Morton B. Stephenson (Read by J. B. Garrett), "Weches Eocene Ostracoda from Smithville, Texas"

Frederick M. Swain, "Middle Mesozoic Non-Marine Ostracoda"

Heinz A. Lowenstam, "Root Morphology and Mode of Attachment of Crotalocrinites"

The following papers were read by title:

F. B. Plummer, "Types and Origins of Central Texas Limestones"

Charles E. Decker, "Additional Graptolites and Hydrozoan-like Fossils, Big Canyon, Oklahoma"

E. R. Applin, "A New Foraminiferal Fauna from Beds of Lewisville (Early Upper Cretaceous) Age in Texas"

H. B. Stenzel, "Gryphaeas."

The annual business session of the Society began at 4:30 P.M., Wednesday, April 3, with President John R. Sandidge in the chair.

The minutes of the 1945 meeting were approved as published in the JOURNAL OF PALEONTOLOGY, vol. 19, no. 4, July 1945.

The following reports were given:

1. *Report of the Editor of the* JOURNAL OF PALEONTOLOGY *(J. Marvin Weller).*—Volume 19 of the JOURNAL OF PALEONTOLOGY, issued in conjunction with the Paleontological Society in 1945, contains 664 pages and 69 collotype plates. Published in it are 52 paleontological papers, 2 bibliographies, 1 paper each in the fields of speciation, biometrics and technique, 14 notes, 10 reviews, data relating to the activities and memberships of the two societies, and various errata.

The March, July and November issues were prepared by your editor in behalf of the Society of Economic Paleontologists and Mineralogists. These numbers consist of 304 pages and 40 collotype plates, a decrease of 13 pages and 9 plates from the previous volume. The contributions in these numbers may be classified as follows:

	Paleozoic	*Mesozoic*	*Cenozoic*
Algae			1
Foraminifera		1	3
Graptolites	2		
Corals	2		
Stromatoporoids	2		
Bryozoa	2		
Conodonts	2		
Pelecypoda			2
Gastropoda	2		
Pteropoda			1
Cephalopoda	3		
Trilobita	1		
Ostrocoda	3		2

Six of these papers describe fossils collected in foreign countries and Alaska. In addition, two papers are devoted to bibliography and one each to speciation and stereophotography.

The situation with regard to manuscripts submitted for publication has improved slightly during the last year, but good papers, particularly on micropaleontological subjects, are earnestly desired by your editor.

2. *Report of the Editor of the Journal of Sedimentary Petrology* (*W. H. Twenhofel*).—

The Journal of Sedimentary Petrology published eleven articles during the fiscal year of 1945–46. In addition, there were a number of reviews and announcements. Difficulty was experienced in obtaining manuscripts to meet the needs of the Journal. This problem has now been met and more than enough manuscripts have been submitted in the last six weeks to care for the August number and most of the December. As in the past, too few members of the S.E.P.M. submit articles. It is urged that the members correct this matter and submit articles. Perhaps there is hesitation on the part of members for fear that what they have to contribute is not suitable for the Journal. The Editor wishes to state that he wishes to encourage contributions from the younger members of the Society.

3. *Report of the Secretary-Treasurer* (*H. B. Stenzel*).—

BACK VOLUME SALES

Back volumes of the Journal of Paleontology	$1,353.00
Back volumes of the Journal of Sedimentary Petrology	227.20

PRINTING AND ENGRAVING BILLS FOR 1945

Journal of Paleontology

	Banta Printing Bills	*Meriden Engraving Bills*	*Total Printing and Engraving Bills*	*S.E.P.M. Total Printing and Engraving Bills*
Number 1 (January)*	$ 621.74	$ 181.19	$ 802.93	$
Number 2 (March)	661.36	322.99**	984.35	984.35
Number 3 (May)*	1,008.17	223.65	1,231.82	
Number 4 (July)	684.96	274.97	923.93	923.93
Number 5 (September)*	800.44	278.92	1,079.36	
Number 6 (November)	845.62	397.00	1,242.62	1,242.62
	$4,586.29	$1,678.72	$6,265.01	$3,150.90
(1944 Totals)	($4,036.58)	($2,152.33)	($6,188.91)	($3,395.71)

* Odd numbers paid by Paleontological Society.
** Less $42.30—Part payment by author.

Journal of Sedimentary Petrology

Number 1 (April)	$ 258.10
Number 2 (August)	237.44
Number 3 (December)	262.52
	$ 752.06
(1944 Total)	($1,050.69)

MEMBERSHIP, MAILING, AND JOURNAL STATISTICS

	March 1946	*March 1945*	*March 1944*
1. S.E.P.M. Membership:			
Active Members	279	268	254
Associate Members	77	75	69
Total	356	343	323
2. Journal of Paleontology Mailing List:			
S.E.P.M. Active Members	218	212	203
S.E.P.M. Associate Members	49	49	47
S.E.P.M. Subscribers	380	308	283
P.S. Members	343	332	323
Total	990	901	856
3. Journal of Sedimentary Petrology Mailing List:			
S.E.P.M. Active Members	139	133	116
S.E.P.M. Associate Members	26	25	19
S.E.P.M. Subscribers	283	245	213
Total	448	403	348
4. Number of pages in 1945 Journal of Paleontology	664 (565, 1944)		
5. Number of plates in 1945 Journal of Paleontology	88 (93, 1944)		
6. Total edition of 1945 Journal of Paleontology	1300 (1300, 1944)		
7. Number of pages in 1945 Journal of Sedimentary Petrology	104 (148, 1944)		
8. Total edition of 1945 Journal of Sedimentary Petrology	500 (500, 1944)		
New members from March 1, 1945 to March 1, 1946	16 (15, 1944–1945)		
New associates from March 1, 1945 to March 1, 1946	3 (10, 1944–1945)		
Transfers to active membership, March 1, 1945 to March 1, 1946	1 (3, 1944–1945)		
Reinstatement to active membership, March 1, 1945 to March 1, 1946	3		

FINANCIAL STATEMENT, DIVISION OF PALEONTOLOGY AND MINERALOGY, FOR THE YEAR 1945

To the Council,
Society of Economic Paleontologists and Mineralogists.

We have examined the balance sheet of SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS at December 31, 1945 and the statement of income for the year then ended, have reviewed the accounting procedures of the Society, and, without making a detailed audit of the transactions, have examined or tested accounting records of the Society and other supporting evidence, by methods and to the extent we deemed appropriate. Our examination was made in accordance with generally accepted auditing standards applicable in the circumstances and included all procedures which we considered necessary.

In our opinion, the accompanying balance sheet and statement of income present fairly the position of Society of Economic Paleontologists and Mineralogists at December 31, 1945, and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

(Signed) ARTHUR YOUNG & COMPANY, *Accountants and Auditors*

TULSA, OKLAHOMA
February 1, 1946

BALANCE SHEET
DECEMBER 31, 1945

ASSETS

CURRENT ASSETS:		
Demand deposits		$ 4,054.35
Savings deposit		2,254.02
Accounts receivable less reserve, $114.00		152.11
TOTAL CURRENT ASSETS		$ 6,460.48
PUBLICATIONS:		
24,872 Journals of Paleontology issued prior to 1945 (comprising 4,221 complete volumes) at $.50 per Journal	$12,436.00	
1,983 Journals of Paleontology, issues 1 to 6 of 1945, at cost	1,641.35	
4,666 Journals of Sedimentary Petrology issued prior to 1945 (comprising 1,585 complete volumes) at $.50 per Journal	2,333.00	
328 Journals of Sedimentary Petrology, issues 1, 2 and 3 of 1945, at cost	200.08	16,610.43
FURNITURE AND FIXTURES less reserve, $385.50		97.10
TOTAL ASSETS		$23,168.01

LIABILITIES AND SURPLUS

CURRENT LIABILITIES:		
Accounts payable		$ 218.59
Amount payable to Paleontological Society		516.60
Donations received for International Commission on Zoological Nomenclature		322.00
TOTAL CURRENT LIABILITIES		$ 1,057.19
DEFERRED INCOME:		
Subscriptions to Journals	$ 1,977.96	
Membership dues for 1946 and 1947	1,223.65	3,201.61
SURPLUS:		
Balance, December 31, 1944	$18,217.44	
Net income for year ended December 31, 1945 (per statement attached)	691.77	
Balance, December 31, 1945		18,909.21
TOTAL LIABILITIES AND SURPLUS		$23,168.01

STATEMENT OF INCOME FOR YEARS ENDED DECEMBER 31, 1945

INCOME:		
Membership dues and subscriptions—		
Journal of Paleontology and Sedimentary Petrology	$ 776.00	
Journal of Paleontology	3,005.90	
Journal of Sedimentary Petrology	922.82	$4,704.72
Sales of back numbers—		
Journal of Paleontology	$1,120.60	
Journal of Sedimentary Petrology	205.00	1,325.60
Sales of plates and reprints		194.63
Advertising		62.46
Donation from American Association of Petroleum Geologists		1,000.00
Miscellaneous		37.98
TOTAL INCOME		$7,325.39
Less: Proportion of income accrued to Paleontological Society		516.60
NET INCOME		$6,808.79

COST AND EXPENSES:		
Cost of printing—		
Journal of Paleontology	$3,240.46	
Journal of Sedimentary Petrology	894.40	
	$4,134.86	
Clerical salaries	1,066.25	
Office supplies and expenses	121.04	
Office rent	360.00	
Postage, telegraph and delivery expense	278.95	
Audit fee	100.00	
Insurance and bond	54.85	
Depreciation	48.26	
Taxes	39.81	
Miscellaneous	60.33	
TOTAL COSTS AND EXPENSES	$6,264.35	
Less: Increase in inventory of publications	147.33	6,117.02
NEW INCOME		$ 691.77

It was moved, seconded, and carried that all reports be accepted.

4. It was moved, seconded, and carried that the Society ratify the constitution of the American Geological Institute (compare Bull. Amer. Assoc. Petr. Geol., vol. 29, no. 2, pp. 240–245, 1945).

5. It was moved that the Society adopt the nine by-laws of the Joint Committee on Zoological Nomenclature for Paleontology in America; and confirm the appointment of J. Brookes Knight as Director, representing the S.E.P.M. on said Joint Committee. The by-laws were read by H. B. Stenzel, and after a discussion the motion was seconded and carried.

6. It was moved, seconded, and carried that the Society endorse the work and program of the Department of Micropaleontology of the American Museum of Natural History and compliment it on its proposed program of expansion.

7. It was moved, seconded, and carried that a resolution of thanks be sent to the A.A.P.G. Executive Committee for the donation of $1,000.00 for the Society's operating funds in 1945–1946.

8. It was moved, seconded, and carried that an expression of thanks be sent to the A.A.P.G. Executive Committee for its excellent arrangement of the 1946 convention.

9. A committee on Rehabilitation of Foreign Libraries, consisting of Norman Newell, J. Brookes Knight, and Stanley G. Wissler, was appointed by President Sandidge to present plans for the handling of requests for S.E.P.M. publications.

10. The results of the election of officers by mailed ballot, for the new year, were announced by Secretary Stenzel as follows:

President: F. W. Rolshausen

Vice-President: Cecil G. Lalicker

Secretary-Treasurer: H. B. Stenzel

The business session adjourned at 5:30 p.m., Wednesday, April 3, 1946.

The technical session, entitled "Permian Symposium," was held on Thursday, April 4, from 9:00 A.M. until 12:00 noon with Ronald K. DeFord presiding. The following papers were presented:

Raymond C. Moore and Russell M. Jeffords, "New Permian Corals"

J. Harlan Johnson, "Notes on Some Permian Algae"

Ralph H. King, "Sedimentation in Permian Castile Sea"

Horace D. Thomas, "Permian Stratigraphy of Uinta Mountains, Utah"

Raymond C. Moore, "Strata of Wolfcamp and Leonard Age in North-Central Texas Region"

John W. Skinner, "Correlation of Permian of West Texas and Southeast New Mexico"

E. Russell Lloyd, "Alternative Permian Correlations—A Discussion"

Phillip B. King, "Permian Correlations—A Discussion"

Following an open discussion of the preceding papers and Permian problems in general, the meeting adjourned at 12:00 noon, April 4, 1946.

ANNUAL MEETING OF THE PALEONTOLOGICAL SOCIETY

The annual meeting of The Paleontological Society for 1946 will be held at the Hotel Stevens, Chicago, December 26 to 28. Because of expected delays in printing, the closing date for the reception of abstracts for inclusion in the program has been advanced to October 15. Nominations for membership must also be in the hands of the Secretary on or before that date. Blank forms for abstracts and nominations may be obtained from the Secretary, H. E. Vokes, Department of Geology, The Johns Hopkins University, Baltimore 18, Md.

BOOKS—WAR VICTIMS

During the war, the libraries of half the world were destroyed in the fires of battle and in the fires of hate and fanaticism. Where they were spared physical damage, they were impoverished by isolation. There is an urgent need—now—for the printed materials which are basic to the reconstruction of devastated areas and which can help to remove the intellectual blackout of Europe and the Orient.

There is need for a pooling of resources, for coordinated action in order that the devastated libraries of the world may be restocked as far as possible with needed American publications. The American Book Center for War Devastated Libraries, Inc. has come into being to meet this need. It is a program that is born of the combined interests of library and educational organizations, of government agencies, and of many other official and non-official bodies in the United States.

The American Book Center is collecting and is shipping abroad scholarly books and periodicals which will be useful in research and necessary in the physical, economic, social and industrial rehabilitation and reconstruction of Europe and the Far East.

The Center cannot purchase books and periodicals; it must depend upon gifts from individuals, institutions, and organizations. Each state will be organized to participate in the program through the leadership of a state chairman. Other chairmen will organize interest in the principal subject fields. Cooperation with these leaders or direct individual contributions are welcomed.

Books, periodicals and reprints in the fields of geology and paleontology are needed. They should be sent PREPAID to THE AMERICAN BOOK CENTER, C/O THE LIBRARY OF CONGRESS, WASHINGTON 25, D. C.

ERRATA

The following corrections to my paper on "Genera and Subgenera of the Pelecypod Family Glycymeridae and Restudy of some Miocene Species of Glycymeris from Central America and Colombia (Vol. 19, No. 6)" should be noted:

Page 617, column 2, line 42: *Axinaeoderm* should read *Axinaeoderma*.

Page 620, column 2, line 9: lanellibranches should read lamellibranches.

Page 620, column 2, line 14: 5ome should read tome.

Page 623, column 1, line 28: cent should read cene.

Page 624, column 2, line 47: austilt Jahrb. should read anstalt Jahrg.

DAVID NICOL

OFFICERS OF THE SOCIETIES

THE SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

For the year ending March 1947

President, F. W. Rolshausen, Houston, Tex.

First Past-President, John R. Sandidge, San Antonio, Tex.

Second Past-President, Donald D. Hughes, Stanford University, Calif.

Vice-President, Cecil G. Lalicker, Norman, Okla.

Secretary-Treasurer, H. B. Stenzel, Austin, Tex.

Editors

J. Marvin Weller, Chicago, Ill., for paleontology.

W. H. Twenhofel, Orlando, Fla., for mineralogy.

THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

For the year ending March 1946

President, Earl B. Noble, Los Angeles, Calif.

Past-President, M. G. Cheney, Coleman, Tex.

Vice-President, D. Perry Olcott, Houston, Tex.

Secretary-Treasurer, Edward A. Koester, Wichita, Kan.

Editor, Gayle Scott, Fort Worth, Tex.

THE PALEONTOLOGICAL SOCIETY

For the year ending December 1946

President, J. Brookes Knight, Washington, D.C.
Vice-President, Thomas H. Clark, Montreal, Canada
Secretary, H. E. Vokes, Baltimore, Md.
Treasurer, C. O. Dunbar, New Haven, Conn.
Editor, C. Wythe Cooke, Washington, D.C.
Chairman, Cordilleran Section, W. P. Popenoe, Pasadena, Calif.

Ex-Presidents

John B. Reeside, Jr., Washington, D.C., 1943.
B. F. Howell, Princeton, N. J., 1944.
Chester Stock, Pasadena, Calif., 1945.

JOINT COMMITTEE ON ZOOLOGICAL NOMENCLATURE FOR PALEONTOLOGY IN AMERICA

Sponsored by the Society of Economic Paleontologists and Mineralogists, The Paleontological Society, and The Society of Vertebrate Paleontology in support of the International Commission on Zoological Nomenclature

Policy Board

J. Brookes Knight, *Chairman* (SEPM); J. B. Reeside, Jr. (PS); A. J. Romer (SVP)

Members

Alfred G. Romer A. Myra Keen Helen Jeanne Plummer Gayle Scott	1946
J. Brookes Knight Raymond C. Moore Henryk B. Stenzel John W. Wells	1946–1947
John B. Reeside, Jr. G. Arthur Cooper Norman D. Newell George Gaylord Simpson	1946–1948

Address all communications to the chairman, J. Brookes Knight, U. S. National Museum, Washington 25, D. C.

THE GEOLOGICAL SOCIETY OF AMERICA

For the year ending December 1946

President, N. L. Bowen, Chicago, Ill.
Past-President, E. W. Berry, deceased.

Vice-Presidents

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Chester Stock, Pasadena, Calif.
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Secretary, H. R. Aldrich, New York, N.Y.

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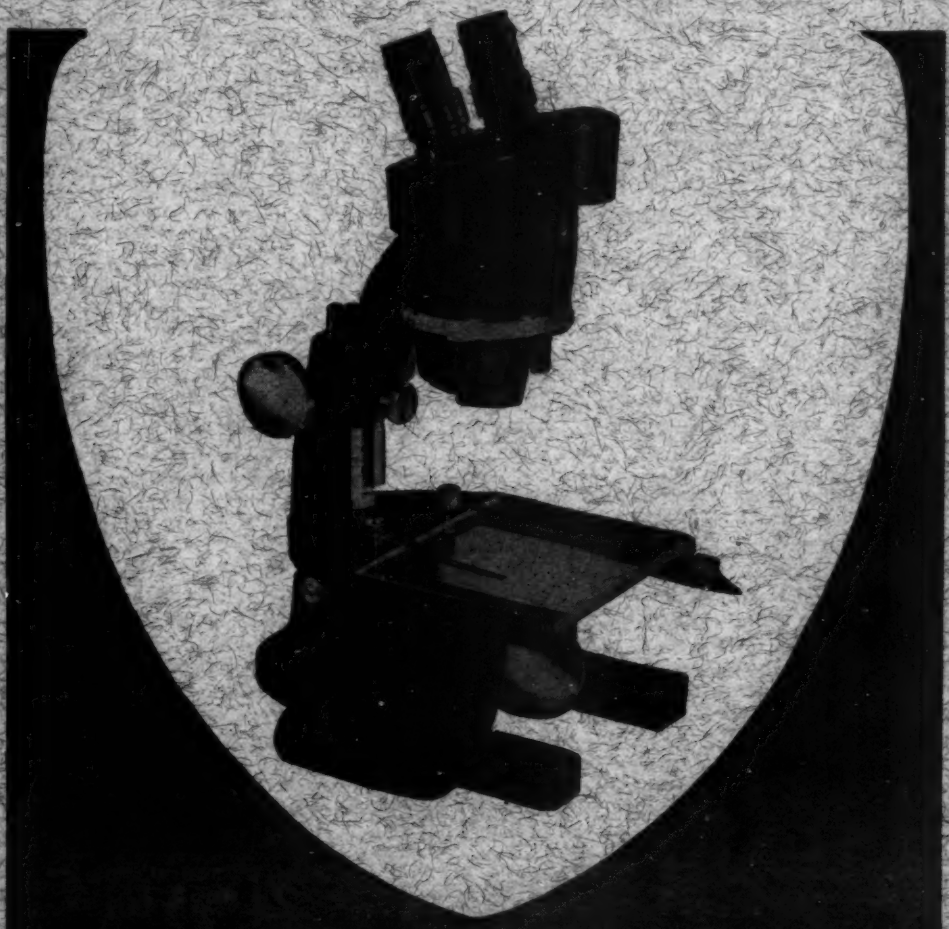

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